rf

INSTRUCTION MANUAL

HB-805

RF-805 AMPLIFIER

RF COMMUNICATIONS, INC. ■ ROCHESTER, NEW YORK, U.S.A.
Division of Harris Intertype Corp.

General

The addendum covers all RF-805 units which contain the Overcurrent Protection Assembly A9. The Overcurrent Protection Assembly is included in all units manufactured after serial number 603. The addendum includes the Schematic Diagram, Component Location, Principles of Operation, Replacement Parts List and Alignment Procedure for the Overcurrent Protection Assembly A9.

The following changes and errata should be incorporated in the RF-805 Instruction Manual, HB-805:

1. Add to Table of Contents under CHAPTER 4 PRINCIPLES OF OPERATION,

"4.9 Overcurrent Protection Circuit 4-7/4-8"

2. Add to LIST OF ILLUSTRATIONS,

"6.3 Overcurrent Protection
Schematic Diagram 6-15/6-16"

3. Insert new page 4-7/4-8 into Instruction Manual.

4. Delete present Paragraph 5.3.6 OVERDRIVE ADJUSTMENT and insert new paragraph 5.3.6 OVERDRIVE ADJUSTMENT.

5. Add new page 6-8A to REPLACEMENT PARTS LIST.

6. Add the following to TABLE 6-3 LIST OF ASSEMBLIES,

"OVERCURRENT PROTECTION PCB ASSY. A9"

7. Insert new page 6-15/6-16, Overcurrent Protection Schematic Diagram, Component Location

4.9 Over-Current Protection Circuit (A9)

Refer to the schematic diagrams in figures 6-1 and 6-3. The current in the output transistors is monitored by measuring the voltage drop across the emitter resistance of Q5 at TP1 on the Output Transistor Assembly, A8. The current in the output transistors is equal and is proportional to the voltage drop across the emitter resistance. The voltage at A8TP1 is filtered and compared in a differential amplifier to a reference voltage by the Over-Current Protection Circuit A9. If the voltage at the base of A9Q1 exceeds the reference voltage set by pot R5, Q1 will turn on. The signal from A9Q1 is then applied to the Overdrive Amplifier A3 which will then turn off A4Q5. When transistor A4Q5 is off, the overall gain of the amplifier is reduced by more than 40 dB, and therefore the output transistors essentially become undriven.

The Over-Current Protection Printed Circuit Board is mounted directly behind the front panel meter, M1, using two stand-offs.

5.3.6. OVERDRIVE ADJUSTMENT.

a. Rotate potentiometer A9R5 on the Overcurrent Protection Assembly A9 fully counter clockwise as viewed from the top of the RF-805. Perform steps a. through f. of the RF check and Alignment Procedure, section 5.3.4.

b. Disconnect coax from A3E1 and A3E2 on overdrive circuit board. Slowly increase the RF signal generator amplitude until 100 mv is indicated on the input voltmeter. The overdrive indicator may illuminate.

c. Potentiometers A3R11 and A3R20 on the overdrive circuit board provide coarse and fine control of the overdrive threshold, respectively. See figures 5-4 and 5-9. Adjust these potentiometers so that the indicator just goes out. Reconnect coax to terminals A3E1 and A3E2 with coax shield to A3E2.

d. Adjust the RF signal generator for an 80 MHz, 23.5 Vrms indication, on the HP-410B voltmeter at the output of the amplifier. Rotate potentiometer A9R5 clockwise until the overdrive indicator just illuminates. Reduce RF signal generator output until the indicator goes out, slowly increase signal generator until the indicator just illuminates. Verify that output is 23 to 24 Vrms. Readjust A9R5 as required.

TABLE 6-1. REPLACEMENT PARTS LIST (CONT.)

REF. DESIG.	DESCRIPTION	MER CODE	PART NO.
A9	OVERCURRENT PROTECTION		
	PCB ASSY	14304	805-0112
A9R1	Res, film, 330 ohm, 5% 1/4 W	87730	LCA0309
A9R2	Res, film, 390 ohm, 5% 1/4 W	87730	LCA0309
A9R3	Res, film, 5.6 K, 5% 1/4 W	87730	LCA0309
A9R4	Res, film, 5.6 K, 5% 1/4 W	87730	LCA0309
A9R5	Pot, vertical PCB mounting, 2.5 K linear	14304	RX200252
A9R6	Res, film, 330 ohm, 5% 1/4 W	87730	LCA0309
A9C1	Cap, tant, 1.0uf, 35 VDCW	14304	CX15010350
A9C2	Cap, tant, 1.0uf, 35 VDCW	14304	CX15010350
A9Q1	Xstr, sil, NPN, 2N3568	07263	2N3568
A9Q2	Xstr, sil, NPN, 2N3568	07263	2N3568

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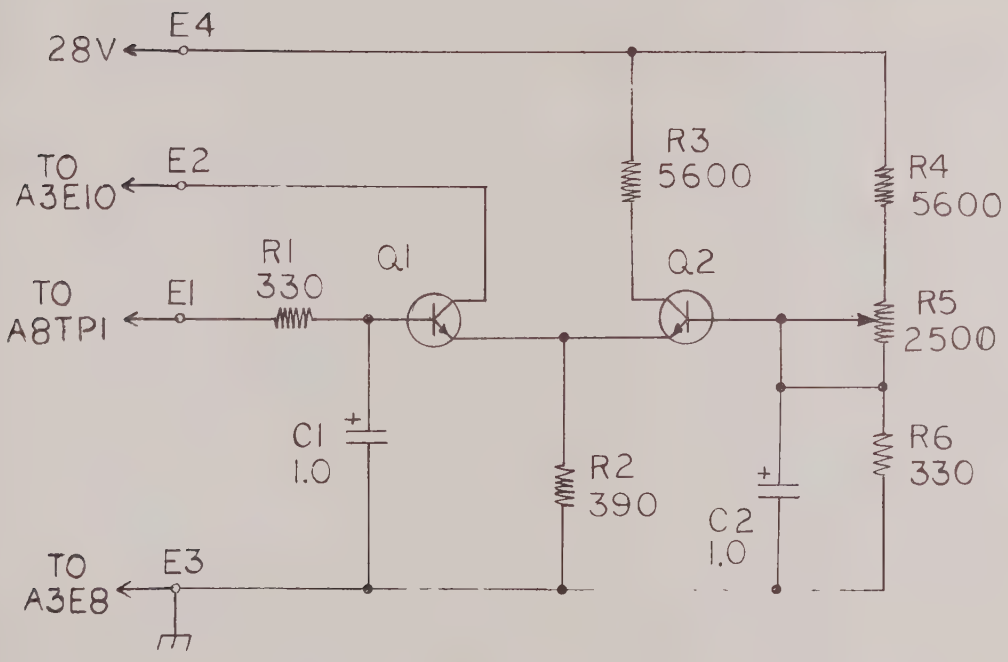
A9 OVERCURRENT PROTECTION



COMPONENT LOCATIONS

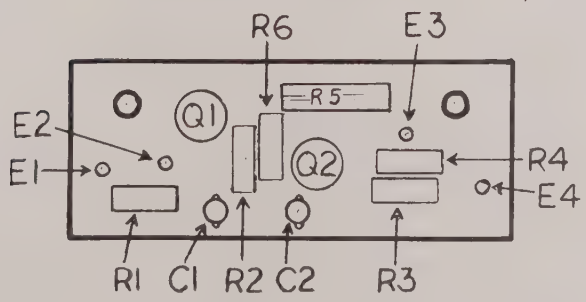


Figure 6-3. Over-Current Protection, Schematic Diagram, Component Location

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WARRANTY

The Electronic Instrumentation Operation of R F Communications, Inc. warrants each new instrument to be free from defects in material and workmanship for a period of one year after shipment. Repair or replacement, at our option, without charge (f.o.b. factory) will be made when our examination indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, and lamps are excluded from warranty coverage. All warranty returns must first be authorized in writing by the factory.

This warranty does not apply to any of our products which have been repaired or altered by persons not authorized by R F Communications, Inc. or not in accordance with instructions furnished by us. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, or if any serial number or seal has been removed or altered, the warranty is void and repairs will be billed at cost.

This warranty is in lieu of all other obligations or liabilities expressed or implied and R F Communications, Inc. neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of its instruments.

REPAIR AND MAINTENANCE

Instruments should be returned only upon prior written authorization from the Electronic Instrumentation Operation of R F Communications, Inc. or its authorized sales and service representative. Warranty repair will be made upon written request. Please provide the following information in order to enable us to serve you efficiently:

1. Model or type
2. Serial number
3. Description of trouble
4. Approximate number of hours of use

Upon receipt of this information our service department will send you service data or shipping instructions. Return shipment must be made in original packing material or equivalent (at least 2 inches of foam completely surrounding unit).

For assistance contact your nearest R F Communications sales representative.

CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION.

The RF-805 is a solid state power amplifier, which has broadband frequency response from 50 kHz to 80 MHz. It produces ten watts with low harmonic and intermodulation distortion. Gain is 47 db minimum, constant within 1 db, and full output is produced with less than 0.1 volt at the 50-ohm input. Most manual and swept tuned signal generators deliver at least 0.1 volt output with a maximum output of +20 dbm. The RF-805 will raise the power of these devices and thus extend the usefulness and versatility of available generators. Output level is accurately metered and displayed on the front panel. Input and output overload protection is provided so that overdrive or operation into a short or open circuit is possible. The amplifier is packaged for bench mounting and has optional rack mounting. The unit has a self-contained power supply, which can operate from 115 or 230 vac 50/60 Hz.

The RF-805 is designed to raise the power level of signal sources and generators without requiring tuning or band-switching of the amplifier. Testing and calibration work can be performed with greater speed and convenience than was previously possible. AM, FM, PULSE, SSB, and other modulated signals can be amplified to high power levels with minimum distortion.

The RF-805 has applications in the laboratory with signal generators and power splitters and applications in other instrumentation, such as exciter driver stages for transmitters and power stages in harmonic-generator chain and for wide-band power pulse devices. Receiver testing, wattmeter calibration, antenna testing, RFI testing, attenuator measurements, and filter and component testing are also aided with the use of this equipment.

1.2 SPECIFICATIONS.

Nominal physical and electrical specifications are listed in table 1-1.

1.3 ACCESSORIES.

A rack mounting kit (RF Part No. 805-0075-2) is available as an option. Using this kit, the instrument may be mounted in a standard 19 inch rack, and connections are made at the front panel.

A similar rack mount kit (RF Part No. 805-0075-1) is available with feed through type BNC connectors mounted in the rack panel adapters. This option allows short jumper cables to be connected from the instrument's input and output connectors to the feedthrough connectors, so that cables can be attached from the rear of the rack.

Both kits are furnished with necessary hardware and information for installation and use of these accessories.

TABLE 1-1. RF-805 SPECIFICATIONS

FREQUENCY RANGE:	50 kHz to 80 MHz in one band
OUTPUT LEVEL AND RESPONSE:	10 watts into 50-ohm load within 1 db over the range
GAIN:	47 db min. (0.1 volt max. input to 10 watts output at 50 ohms)
HARMONIC OUTPUT:	More than 30 db down at full output
INTERMODULATION DISTORTION:	50 kHz to 80 MHz, -30 db; better at less than full output level and at lower than 80 MHz.
SPURIOUS OUTPUT:	Hum and noise level more than 70 db down
OUTPUT METERING:	Voltage 2 scales (3% f.s. accuracy): 0-7 volts and 0-30 volts Watts (50 ohms) 2 scales (6% f.s. accuracy): 0-1 watts and 0-15 watts
TYPES OF SIGNAL:	AM, FM, PULSE, SWEEP, SSB, etc. Limited only by frequency, bandwidth, and power output capability
POWER REQUIREMENTS:	115 or 230 vac $\pm$ 10%, 50/60 Hz
SIZE:	5 $\frac{1}{4}$ x 8 $\frac{1}{2}$ x 14 $\frac{1}{4}$ in.
WEIGHT:	20 lbs.
INPUT IMPEDANCE:	50 ohms (higher impedance optional)
INPUT VSWR:	1.3:1
INPUT-OUTPUT CONNECTORS:	BNC
INPUT OR OUTPUT OVERLOAD:	Lamp warning and automatic protection
OVERLOAD PROTECTION:	
Input - - -	Overdrive protected to 3 volts RMS input
Output - -	Short and open circuit protected at nominal input
MOUNTING:	Bench use with rack mounting optional

1.4 INSTRUMENT IDENTIFICATION.

R F Communications, Inc. identifies each model RF-805 Amplifier with a serial number tag. On units prior to serial number 271, the tag is located behind the front panel, on the inside of the amplifier. Subsequent units have a serial number tag located on the rear panel of the instrument. Both the model number and the serial number should be given in any correspondence with the factory representative.

CHAPTER 2
PREPARATION

2.1 INITIAL INSPECTION.

2.1.1 MECHANICAL CHECK.

If damage to the shipping carton is evident, ask that the Carriers Agent be present when the instrument is unpacked. Check the equipment for damage, and inspect the cabinet and panel surfaces for dents and scratches.

2.1.2 CLAIM FOR DAMAGE.

If the RF-805 Amplifier is mechanically damaged or fails to meet specifications upon receipt, notify the Carrier and nearest R F Communications, Inc. Representative immediately. Retain shipping carton and packing material for the Carrier's inspection as well as the subsequent use in returning the unit if necessary. For assistance at any time, including assistance with instruments under warranty, contact your R F Communications, Inc. Representative.

2.1.3 PERFORMANCE CHECK.

The electrical performance of the RF-805 Amplifier should be verified as soon as possible after receipt. Following is a performance check that is suitable for incoming inspection.

Test equipment required for the performance check is as follows:

VTVM, H-P 410B or equivalent with rf probe and T-probe adapter with BNC connectors.
RF Dummy Load, 50-ohms, 20 watts.
RF Signal Generator, Tektronix 191 or equivalent.
RF Voltmeter, Boonton 91H or equivalent.
BNC T-connector.

a. Check that the 115/230V switch on the rear panel is in the correct position and check that the fuse is of correct value and not blown. (See section 2.2.1.)

b. Remove the top and side covers of the amplifier. (Refer to section 5.5.3.)

c. Visually inspect the entire assembly for evidence of damage or mechanical failure such as:

(1) Covers, handles, panels or frame, scratched or dented.

(2) Loose subassemblies or hardware.

(3) Broken components.

(4) Frayed, pinched, loose, or broken harness wires.

(5) Loose or shorted printed circuit board.

d. Replace covers, and secure.

e. Plug in line cord, with the POWER switch off.

f. Set the amplifier front panel POWER switch to the ON position, and quickly check that the power switch illuminates and that the fan motor runs. The OVERDRIVE lamp should not be lit.

CAUTION

Turn the POWER switch off immediately if positive results are not obtained.

g. Turn the POWER switch off.

h. Connect the rf signal generator and rf voltmeter to the amplifier input by using a BNC type T-connector on the amplifier INPUT connector.

i. Adjust the rf signal generator for 50 kHz CW signal with a 50 mv output level as measured by the rf voltmeter connected to input of the amplifier.

j. Connect a 50-ohm, 20 watt rf dummy load and an HP-410B VTVM to OUTPUT connector of the Amplifier using a T-probe adapter. See figure 5-1, Amplifier Test Setup.

k. Set the HP-410B to the 30 vac range.

l. Set the METER RANGE switch on the Amplifier to the HI position.

m. Set the Amplifier POWER switch to ON.

n. Adjust the input signal level to provide an indication of 20 V rms on the HP-410B connected to the Amplifier output.

o. Check the level of the input signal as read on the Boonton 91H. This level should be 40 to 80 mv. If it exceeds this limit, there is a malfunction in either the input cabling or the Amplifier Assembly in the unit.

2.2 PREPARATION FOR USE.

2.2.1 POWER REQUIREMENTS

The RF-805 Amplifier requires a power source of 115 or 230 volts AC $\pm$ 10%, 47 to 63 Hz, single-phase, which can supply approximately 115 watts.

The two-position slide switch mounted on the rear panel above the fuse and power cable permits operation from either the 115 or 230 power source. The screwdriver slot in the slider must be pushed toward the 115 or 230 volt label depending upon which line voltage the instrument is to be connected.

Adjacent to the line voltage labeling is marked the correct fuse rating for each line voltage. The fuses are of the slow-blow type and 3AG size. Check to be sure that a fuse of the correct rating is installed.

CAUTION

To avoid damage to this instrument set the 115/230 volt slide switch for the line voltage to be used before connecting the power cable to the power source.

2.2.2 POWER CABLE GROUND PROTECTION.

To protect operating personnel, the RF-805 Amplifier is equipped with a three conductor power cable and plug which, when inserted in an appropriate receptacle, grounds the panel and cabinet. The offset pin on the power cable three-prong connector is the ground pin.

To preserve the protection feature, when operating the instrument from a two contact outlet, use a three-prong adapter and connect the green pigtail on the adapter to ground.

2.2.3 COOLING.

When the instrument is either cabinet or rack mounted, provisions must be made so that there is adequate clearance around the instrument to allow air circulation. The instrument is forced air cooled and the inlet air location is on its rear panel. The exhaust air from the instrument exits through perforations located on both sides of the instrument. Ambient temperature must not exceed 50°C (122°F).

2.3 MOUNTING.

The RF-805 has plastic feet and it is normally set on a bench top. Rack mounting kits are available (section 1.3) to provide front or rear panel connections. The kits are supplied with necessary hardware and instructions for installing the rack mount adapters.

Rack mount Amplifiers can normally be installed with no additional support other than the front panel rack mount adapters provided. However, if the instrument is to be used in an installation which will be subject to severe shock or vibration, additional support must be provided at the rear of the unit.

To facilitate making connections from the rear of a cabinet, one of the rack mount kits is available with feedthrough BNC connectors mounted on the rack mount adapters (refer to section 1.3).

To use this feature, connect short BNC jumper cables between the Amplifier front panel INPUT and OUTPUT connectors and the feedthrough connectors. Then normal installation cables can be connected to the rear of the feedthrough BNC connectors from behind the rack mount adapters. Front panel jumper cables can be readily disconnected any time front panel connections would be convenient for tests or connection of optional input/output devices in the installation.

2.4 PACKAGING FOR RESHIPMENT.

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. A carton made of at least 400 lb. test material, will usually provide adequate protection. Use shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. A minimum of three inches of material should be used for each side. Protect the front panel by means of cardboard or other material which will not scratch the meter face or front panel. Use extra material around the outside of projecting parts of the instrument to relieve these parts of any unnecessary shock. Close the carton securely and seal with durable shipping tape.

CAUTION

Mark the shipping container FRAGILE to assure careful handling.

In correspondence relative to this instrument, be sure to refer to the model number and serial number. The location of the serial number tag is described in section 1.4.

CHAPTER 3
OPERATION

3.1 FUNCTIONAL DESCRIPTION.

The RF-805 is a broadband amplifier designed to increase the power capability of any signal generator with a 50-ohm output impedance within the 50 kHz to 80 MHz frequency range of the Amplifier. No tuning or band changing is required. It is a laboratory instrument which is protected against overdrive or harm from operation into high VSWR loads.

Less than 100 mv is required from the generator to obtain rated output of 10 watts peak-envelope-power into a 50-ohm load. Output is only limited by the peak of the signal amplitude. The Amplifier can deliver a full 10 watts output continuously with a constant amplitude signal.

An output meter is provided to indicate the RMS voltage at the OUTPUT connector. For convenience, it is also calibrated in terms of power into a 50-ohm load. The meter responds to average rf level; so the characteristics of the modulation should be considered when interpreting meter indications for an amplitude-modulated signal.

NOTE

1. Instantaneous rf levels above 10 watts peak envelope power will overdrive the unit. Such signals as pulsed signals or amplitude modulated or SSB signals can exceed this level, even though the output meter indicates an average level in the "normal" operating range. Thus, the overdrive circuit may trip with average output levels less than 10 watts with signals of this type.
2. Any amplifier will oscillate if some of the output signal is allowed to return to the input at sufficient amplitude and phase. Use of this unit must include electronic isolation of the output signal and load from the signal source.
3. The output amplifier stage and the output meter circuit which measures voltage at the OUTPUT connector are separated by an output transformer and cable, and the load is generally separated from the Amplifier OUTPUT

Figure 3-1. Front Panel Devices

connector by a length of cable. When operating with other than a 50-ohm load, a voltage standing wave along the lines can create an amplifier overdrive condition, which may not be apparent by observing the front panel meter or a meter at the load. However, the internal protection circuits sense such a condition and automatically cut back the drive and light the OVER-DRIVE lamp.

3.2 CONTROLS, INDICATORS, AND CONNECTORS.

Front and rear panel devices are described in tables 3-1 and 3-2. Front panel devices are identified in figure 3-1, and rear panel devices are identified in figure 5-2.

TABLE 3-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

DEVICE	FUNCTION
POWER Switch	Depressing the top part of the switch turns the instrument on and lights a lamp inside the switch housing.
OVERDRIVE Indicator	Illuminates to indicate that output is being overdriven. Reduction to a drive level at which indicator extinguishes will reduce distortion.
Meter	Indicates output voltage and also power for a 50-ohm load. The meter circuit responds to the average voltage of the signal waveform, and the scales are calibrated in both RMS volts and power in watts. The HI scales are calibrated from 0 to 30 Vrms and 0 to 15 watts. The area of the scale above 22.5 Vrms or 10 watts is shaded in red to indicate that the maximum specified output level has been exceeded. The bottom or LO scales are calibrated from 0 to 1 watt and 0 to 7.2 Vrms.
METER RANGE Selector	Selects HI or LO ranges of the meter.
INPUT Connector	BNC type, for connection of driving signal generator. Input impedance is 50 ohms. No more than 0.1 Vrms is required to obtain full output. Up to 3 volts can be applied without causing damage; however, distortion will result from overdriving the Amplifier.

TABLE 3-1. FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS (Con't)

DEVICE	FUNCTION
OUTPUT Connector	BNC type, for connection of amplified output to a 50-ohm load.

TABLE 3-2. REAR PANEL DEVICES

DEVICE	FUNCTION
115/230 Voltage Selector	Slide switch operated by using flat blade screw driver as a key to select proper power supply connections for available line voltage.
FUSE	Holder requires 3AG size, slow-blow type fuse of rating to correspond to line voltage as marked next to Voltage Selector.
Line Cord	Three prong type plug with safety ground pin connected to cabinet. Use grounding adapter for operation with other than proper power receptacle.
Air Filter	Removes dust and particles from input air and covers blower fan. Requires periodical cleaning (section 5.2), depending on amount of usage and atmosphere.

3.3 OPERATING PROCEDURE.

Refer to the following procedure as a guide to operating the RF-805 Amplifier.

a. Set the 115/230V Voltage Selector switch, on the rear panel, to match the line voltage to be used.

b. Check that the rating of the fuse installed is appropriate for the line voltage used.

c. Connect the load to be driven to the OUTPUT connector on the Amplifier front panel.

d. Place the METER RANGE switch in the HI position.

e. Check that the signal source or generator to be used is adjusted to produce less than .1 Vrms into a 50 ohm load.

f. Connect the signal source or generator to the INPUT connector on the front panel.

g. Turn on the POWER switch. The lamp within the switch housing should illuminate.

h. Adjust the level of the input signal to obtain the desired output level. Set the METER RANGE switch for the most convenient range.

NOTE

If the overdrive lamp illuminates, the output amplifier is being overloaded and the input signal should be reduced until the lamp does not light. This overload condition can occur even though the meter does not indicate greater than 10 watts or 22.5 volts.

3.4 OVERDRIVE PROTECTION.

The OVERDRIVE lamp illuminates when either the input voltage or the output voltage approaches a level which is injurious to the Amplifier. When the OVERDRIVE condition exists, the gain of the Amplifier is greatly reduced, in a non-linear fashion, to protect the transistors in the output stages of the amplifier circuit.

The output voltage is sensed, for the purpose of overdrive protection, at the collectors of the final output amplifier. In addition, the pre-amplifier input voltage is sensed to limit drive voltage and maximum current in the output stage.

At low frequencies, the voltage at the output collectors is equal to one-half of that measured at the load. If, for a given drive level, the load impedance is increased, the voltage at the load and at the transistor collectors will increase. If the load impedance is increased sufficiently, the corresponding increase in collector voltage will be sensed and the overdrive circuit will be activated. If the load impedance is reduced to less than 50 ohms, the voltages at the output collectors and the load decrease, and there is no danger of overload. If however, the input drive to the amplifier is increased beyond 100 mv, the input overdrive circuit will activate regardless of load conditions. In any case, the amplifier is automatically protected.

At higher frequencies, transformer effects of the internal output transformer and coaxial cable and the external test cable can alter the impedance seen at the output stage when using a high VSWR load. The internal circuitry between the output stage and the OUTPUT connector acts like a 45 inch length of coaxial cable. External cables add to this length. The transformer effects can cause OVERDRIVE circuit operation. As an example, at a frequency resulting in quarter-wave resonance of the cables between the output stage and the load, shorting the load will appear at the output stage as an open circuit, and thus the OVERDRIVE indicator will illuminate. Conversely, it would not indicate with an open-circuited load at normal drive level.

From the preceding discussions, it can be seen that full output power may not be available at the load when mismatched, due to either voltage or current limiting in the Amplifier. Full output power should only be expected with a matched load.

If the OVERDRIVE indicator illuminates, reduce the input drive. If the indicator is still illuminated, consider the following possible causes:

a. Defective output cable.

b. Defective load.

c. Transients or spurious signals appearing at the input of the amplifier.

d. Peak envelope of an amplitude modulated input signal exceeding the limiting level.

NOTE

The meter responds to the average level of the output signal, and thus indicates the average level of an amplitude-modulated signal. The envelope peak of such a signal will always be greater than the meter indication, and thus an overdrive condition can exist even though the meter indicates less than 10 watts output into 50 ohms.

e. System oscillation.

f. Defective Amplifier.

3.5 RF SIGNAL SOURCES.

The RF-805 Amplifier has been designed to work from most manual and swept tuned signal generators as well as almost any signal source. The signal source or generator need only produce at least 0.1 volts rms to produce 10 watts into 50 ohms. The output capability of the Hewlett Packard model 606 and 608 signal generators is enhanced by the RF-805. This is also true of General Radio Company and Marconi Instrument signal generators and sources which operate in the same frequency range as the RF-805.

3.6 TYPES OF MODULATION.

The amplifier will adequately work with AM, FM, Pulse, SSB, and any other modulated signal which will work with a band width of 50 kHz to 80 MHz.

3.7 LOAD MISMATCH.

The RF-805 Amplifier may drive any load impedance from a short circuit to an open circuit; however, frequency response gain and power output will all vary depending upon the load impedance.

As a rough guide in predicting performance into non-50-ohm loads, consider the Amplifier output to be a current generator driving a 45 inch long transmission line terminated by the front panel OUTPUT connector. A Smith chart may then be used to transform the load impedance to the driving point impedance seen by the current generator. The current flowing under matched 50-ohm conditions may then be translated to power in the non-50-ohm load by means of the Smith chart. This is a fair approximation for loads close to 50 ohms, but actual performance departs significantly as the VSWR becomes large.

NOTE

At high frequencies, a voltage-standing-wave will exist within the output transformer and the external test cable if the load is other than 50 ohms. Thus, depending upon the frequency, the voltage indicated by the front panel meter can be greater or less than that at the output collectors, by an amount dictated by the VSWR.

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 GENERAL.

The Model RF-805 Amplifier increases the power of an RF input signal up to a level of 10 watts by means of a solid state push-pull amplifier circuit. The RF-805 basically consists of an amplifier circuit, a regulated power supply, protection circuitry, meter circuitry, and cooling apparatus.

4.2 BLOCK DIAGRAM DESCRIPTION.

The RF Amplifier Assembly is divided into three subassemblies. Refer to figure 4-1. The first subassembly consists of low level RF Pre-amplifier and Driver circuitry. The second subassembly, constructed directly on a heatsink, is a high level power amplifier. Attached to the heatsink is an Output Transformer assembly, the output of which goes directly to the front panel OUTPUT connector.

The voltage across the OUTPUT connector is monitored by the Meter Circuit which is switched to a high or low range by the front panel METER RANGE switch. Overdrive circuitry monitors both the input and output signal levels to provide an indication as to overdrive and, in addition, reduces the gain of the driver circuitry, when necessary, to protect the output amplifier. A single 28 volt regulated supply provides all of the operating power for the amplifier and protection circuitry.

Cooling of the output amplifier, where most of the power is dissipated, is provided by means of a blower fan which directs air over the heatsink where the output circuitry is mounted. The air enters the unit from the rear via an air filter. It passes over the amplifier heatsink, around the low level circuitry, and over the power supply heatsink. The air is made turbulent in the section where the power supply heatsink is located, and the exhaust exits through perforations in the side panels of the amplifier.

4.3 RF PREAMPLIFIER AND DRIVER CIRCUIT (A4).

Refer to the schematic diagram in figure 6-1. The input signal is applied to the A4 Pre-amplifier Printed Circuit Board through a coaxial cable which is connected to the front panel INPUT connector. This cable is terminated on the Pre-amplifier Printed Circuit Board by a 50-ohm load. The input load resistors are paralleled with two diodes back to back, which limit the amplitude of an accidentally imposed high input voltage which would otherwise destroy the input stage of the amplifier. Although the nominal input voltage to the amplifier is less than 100 mv, this input protection circuitry permits the application of a three volt RMS signal from a 50-ohm source without causing damage to the amplifier. The input signal appearing across the load resistors is applied to input emitter follower Q1, which serves as a buffer between the input of the Amplifier and subsequent amplifier stages.

The signal at the emitter of transistor Q1 is applied to transformer T1, which converts the single-ended input signal to a push-pull signal for application to differential amplifier stage transistors Q3 and Q4.

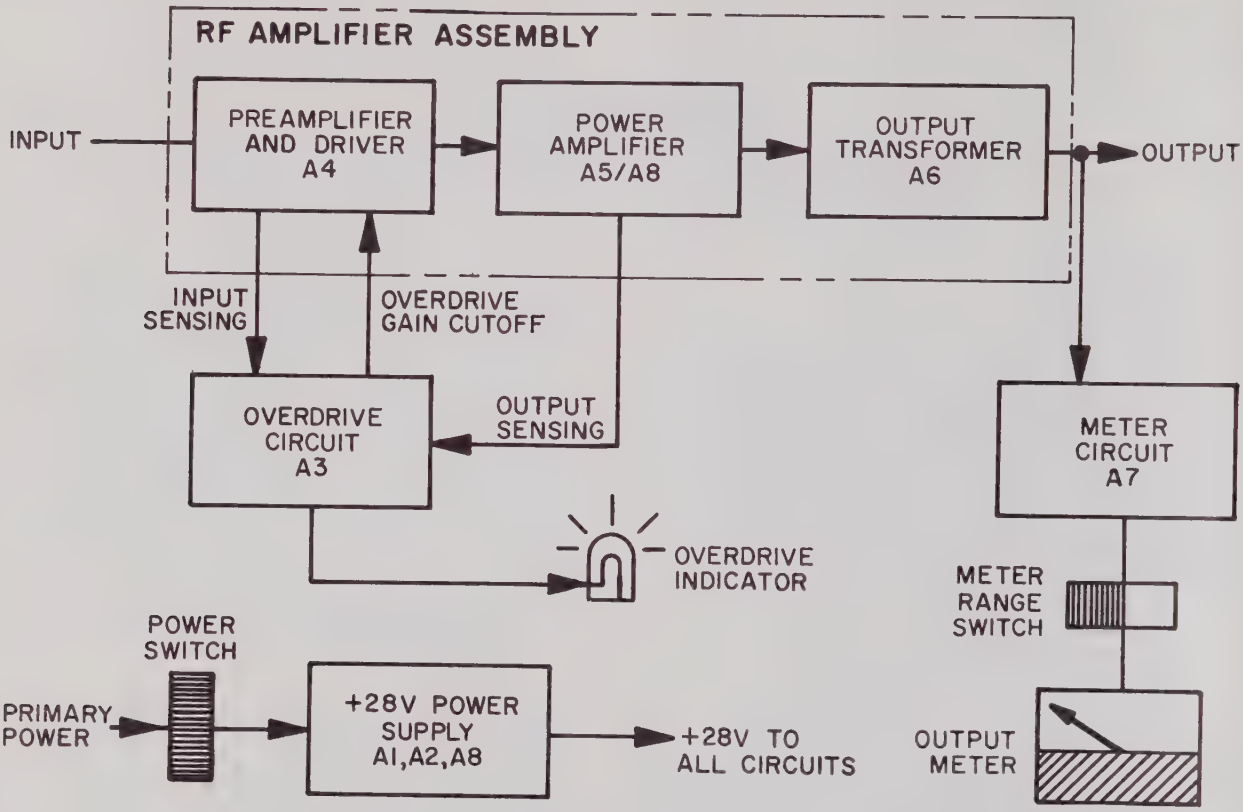


Figure 4-1. RF-805 Functional Block Diagram

The signal is further amplified by emitter follower Q6-Q7 and differential amplifier Q14-Q15. Capacitor C9 in the Q14-Q15 emitter circuit is used to peak the frequency response of the overall amplifier.

The remaining transistors in the signal path, Q8 through Q13, are darlington-connected to deliver sufficient power to drive the final output power stages. Transistors Q2 and Q5 are used in conjunction with the overdrive circuit, and their function is described in section 4.5.

4.4 RF OUTPUT POWER AMPLIFIER CIRCUIT (A5).

Output transistors Q1 through Q4 are operated class A in a modified-darlington push-pull amplifier. These transistors are stud mounted directly to the amplifier heatsink. Nominal collector current for transistors A8Q2-Q5 is approximately 440 ma (each), with a collector to emitter voltage of approximately 27 vdc. The parallel sets of resistors in each of the emitter circuits provides dc feedback to maintain constant bias current and as AC feedback to improve linear frequency response.

Base bias applied to transistors A8Q1 and A8Q4 is derived from a voltage divider consisting of A5R6, A5CR4-CR6, and potentiometer A5R4. The voltage across the diodes and potentiometer is applied through chokes A8L3 and A8L4 to the bases of darlington drivers A8Q1 and A8Q4. The potentiometer provides a fine adjustment of bias current to account for variations in components and transistor tolerances. Thermostat switch A5S1, connect in series

with the +28V to the bias circuit, is mounted directly on the amplifier subassembly heat-sink and is selected to open if the temperature gets greater than 80°C When this thermostat opens, the base bias voltage is removed, thereby reducing the chance of thermal runaway due to a blower failure, blocked air filter, or abnormally high ambient temperature conditions.

Resistors A5R5 and A5R7, in conjunction with center-tapped choke A5L1, provide dc bias current for darlington driver transistors A8Q1 and A8Q4. Signal output current from transistors A8Q1-A8Q6 is applied to push-pull output transformer A6 via miniature, solid coaxial 25-ohm transmission lines D1 and D2. Transformer A6 supplies dc collector current to the output transistors and transforms the single-ended 50-ohm load impedance at the OUTPUT connector to the balanced, push-pull, 25 ohm collector load required by the output amplifier stage. Diodes CR1, CR2, and CR3 are part of the overdrive protection circuit.

4.5 OVERDRIVE SENSING CIRCUITS.

The term overdrive, with respect to the RF-805 Amplifier, applies either when instantaneous collector voltage of the final output transistors exceeds a specified threshold voltage, or the signal current of each output transistor exceeds a specified threshold current. Instantaneous output collector voltage is peak detected by diodes CR1, CR2, and CR3 in the A8 Output Amplifier subassembly. This peak detected voltage is applied through a shielded cable to the Overdrive Amplifier Printed Circuit Board A3, where it is compared to an adjustable threshold voltage.

The output transistor signal current is not measured directly as in the case of peak output voltage. It is assumed that the gain of the pre-amplifier and drivers is constant regardless of output load and therefore, signal current in the output transistors can be predicted from input voltage to the pre-amplifier. The pre-amplifier input voltage is sampled at the emitter of transistor A4Q1. This voltage is amplified by transistor A4Q2 and peak detected by diode A4CR1. This peak detected signal, which is proportional to input voltage, is applied to the Overdrive Amplifier Printed Circuit Board and compared to a threshold voltage.

If either the output voltage threshold or the output current threshold is exceeded, the Overdrive Amplifier Printed Circuit Board generates a control signal which is applied to transistor A4Q5 in the pre-amplifier and Driver Printed Circuit Board. Transistor A4Q5 is a switch which supplies bias current to the first differential amplifier (A4Q3-Q4). When transistor A4Q5 is off, the overall gain of the amplifier is reduced by more than 40 db, and therefore the output transistors essentially become undriven. The protection circuitry is sufficiently fast to protect the amplifier if the load is disconnected or shorted while attempting to get full output power.

4.6 OVERDRIVE AMPLIFIER (A3).

The threshold detecting circuit in Overdrive Amplifier A3 is a high-impedance differential amplifier, consisting of field-effect transistors Q1 and Q2. A fixed bias is applied to the gate of Q1 through resistor R1, and a variable bias voltage is applied to the gate of Q2 through resistor R13. Course and fine adjustment of this variable bias voltage is provided by potentiometers R11 and R20, respectively.

During initial alignment, potentiometers R11 and R20 are adjusted such that diode

CR1 in the source circuits of the differential amplifier is approximately zero-biased. When CR1 is zero-biased, the source currents for Q1 and Q2 are nearly identical, as ensured by source feedback resistors R2 and R3. When the instantaneous collector voltage of power amplifier transistors A8Q2-Q3 and A8Q5-Q6 swings below approximately 6.9 volts, diode A8CR3 conducts, and a negative going signal is applied to the gate of Q1.

A negative signal on the gate of Q1 causes diode CR1 to conduct which causes Q2 to conduct more heavily. The increase in drain current of Q2 causes Q3 to turn on, which in turn turns on Q4. When transistor Q4 is turned on, an overdrive signal, equal to the saturation voltage of Q4, is applied to output terminal E7 of the overdrive board. This overdrive signal is applied to switch transistor A4Q5 in the pre-amplifier circuit as previously described.

In addition to producing the overdrive control signal, transistor Q4 also turns on lamp driver transistors Q5 and Q6. Thus when an overdrive signal is produced, the OVERDRIVE lamp on the front panel of the Amplifier is illuminated, indicating an overdrive condition. Capacitor C6 and diode CR2 in the lamp driver circuit provide a long discharge time constant for the lamp circuit. This insures a visible lamp indication even when the overdrive condition is only several microseconds in duration. Similarly zener diode VR1 in this circuit provides that the lamp drivers are turned on before the control signal is applied to the A4 Pre-amplifier and Driver Printed Circuit Board, thus ensuring that an indication of overdrive will exist just prior to the level at which the amplifier gain is changed. This eliminates the possibility of the control circuit being activated without a front panel lamp indication.

As described previously, a voltage proportional to the input signal is produced by a detector circuit in the Pre-amplifier and Driver Printed Circuit Board. This is a positive voltage, and it is applied to the gate of Q2 in the Overdrive Amplifier Printed Circuit Board. A positive signal on the gate of Q2 has the same effect as that of the negative signal on the gate of Q1, previously described; namely CR1 conducts, which in turn increases the conduction of Q2, which produces the overdrive signal.

4.7 METER CIRCUIT (A7).

The input of the meter circuit consists of a full-wave rectifier, the output of which is applied to front panel METER RANGE switch S3 through resistors R2-R6 and R8 which provide high low ranges for the meter. For convenience, both high and low scales are calibrated in volts and watts. The high range of the meter is 15 watts or 30 Vrms full scale; while the low range is 1 watt full scale, which is approximately 7.15 Vrms.

On the high range meter scale, the graduations above 22.5 Vrms are shaded red. This indicates the maximum allowable output voltage for continuous operation. Depending upon frequency and load mismatch, an indication in the red shaded portion of the meter will also be accompanied by an OVERDRIVE indication and gain limiting within the amplifier.

NOTE

The meter circuit is average-responding and calibrated in volts. If a 100% modulated AM signal is applied to the amplifier input, the output meter will indicate only one-half the peak-envelope rms voltage actually at the output. Thus, it is

possible to encounter overdrive conditions with modulated input signals when the output meter indicates considerably less than 10 watts output. It should be kept in mind that the amplifier is rated at 10 watts P.E.P. and average, so a full drive CW signal can be applied without harm.

4.8 POWER SUPPLY CIRCUIT.

Refer to figure 6-2. Input power is applied from the power cable through a fuse to line filter FL1. From the line filter, the input power is applied through POWER switch S1 and voltage selector switch S2 to power transformer T1. When S2 is in the 115V position, both primary windings of transformer T1 are in parallel; in the 230V position, the windings are in series. When POWER switch S1 is energized, power is applied to the primary windings of T1, and approximately 40 volts appears at the secondary.

The secondary voltage of T1 is applied to bridge rectifier CR1 and filter capacitor C2. The output from the rectifier is applied to a series regulator, consisting of Regulator Printed Circuit Board A1 and Power Supply Heatsink Assembly A2. This is a conventional series-regulated power supply circuit, except that the series-regulating transistors (A2Q1-Q2) are in the ground-return line.

The regulated output voltage appears across a voltage divider, consisting of A1R1, A1CR1, potentiometer A1R2, and resistor A1R3. The voltage at the wiper of potentiometer A1R2 is compared to a reference voltage developed by zener diode A1VR1. Transistors A1Q1 and A1Q3 amplify the differences between the pick-off voltage and the reference voltage, and the resulting signal is applied to series regulator transistors A2Q1-Q2.

Transistor A1Q2 is a constant-current source, which limits the maximum drive applied to the series regulator transistors. Potentiometer A1R7 enables this current limit to be adjusted.

In the event that the regulated power supply is shorted to ground, the maximum drive to transistors A2Q1-Q2 is limited by the constant-current source; therefore, the regulated voltage drops from its nominal value of 28 volts. As the voltage drops, zener diode VR2 in the A1Q2 collector circuit causes constant-current source A1Q2 to go into saturation, thereby further reducing the current drive available to the series-regulator transistors. As a result, the short-circuit current capability of the power supply is greatly reduced from its nominal current capacity of 4 amps. During initial adjustments potentiometer A1R7 is adjusted so that the power supply current will limit at approximately 4 amp, and voltage-adjust potentiometer A1R2 is adjusted for +28V with a 3 amp load.

CHAPTER 5
MAINTENANCE AND CALIBRATION

5.1 GENERAL.

All subassemblies are easily accessible for maintenance and repair. All four covers of the instrument may be removed to provide access for troubleshooting or subassembly replacement. Figures 5-2 through 5-10 show all subassemblies and printed circuit boards and identify major components.

5.2 PERIODIC MAINTENANCE.

The RF-805 needs a minimum of maintenance. The only specific requirements are periodical cleaning of the air filter and lubrication of the motor.

The air filter should be visually checked every few weeks and cleaned if dirty. More frequent inspections and cleanings are required under severe operating conditions. To clean the filter, place it under a water faucet and flush the dirt from its screening and let it dry. Refer to section 5.5.12 for removal procedure.

The fan motor bearings should be lubricated every three or four months with a few drops of light machine oil. There are two holes, one next to each of the bearings, through which oil is applied to felt pads.

5.3 PERFORMANCE TEST AND ALIGNMENT PROCEDURE.

5.3.1 GENERAL.

The RF-805 Amplifier is aligned at the factory and, in general, should not require realignment except following the replacement or repair of a subassembly. The following procedure is offered as a guide to alignment and an indication of proper equipment operation. It is not meant to test the amplifier against every detail in the equipment specification. If there is any evidence of malfunction, refer to TROUBLESHOOTING, section 5.4.

5.3.2 TEST EQUIPMENT.

Test equipment required for measuring Amplifier performance, and alignment is listed below. Equivalent substitutes for recommended models may be used.

Boonton 91H Voltmeter
HP-410B Voltmeter with T-probe Adapter
Simpson 260 Voltmeter
Tektronix Type 191 Signal Generator
50 ohm, 20w RF Dummy Load
8 ohm, 150w DC Load Resistor or Rheostat
Harrison Lab 6266B Power Supply
(28V, 3.5 amps, current limiting required)
Rotron 5 in. Muffin Fan with line cord.

5.3.3 PRELIMINARY MECHANICAL AND POWER SUPPLY TEST.

a. Check that the 115/230V slide switch on the rear panel is in the correct position, and check that the fuse is of correct value and not blown.

b. Remove all covers of the amplifier. (Refer to section 5.5.3.)

c. Visually inspect the entire assembly for evidence of damage or mechanical failure such as:

(1) Covers, handles, panels, or frame scratched or dented.

(2) Loose subassemblies or hardware.

(3) Broken or burned components.

(4) Frayed, pinched, loose, burned, or broken harness wires.

(5) Loose or shorted printed circuit board pin connectors.

d. Set 115/230V Voltage Selector on rear panel of amplifier, to the 115V position.

e. Set POWER switch on the front panel of the amplifier to the ON position.

f. Using an ohmmeter, measure the resistance between the two flat terminals of the amplifier line cord. The meter should indicate approximately 1.5 ohms.

g. Set 115/230 Voltage Selector on the rear panel to the 230V position, and again check the line plug resistance. A correct indication is approximately 5 ohms.

h. Return 115/230 Voltage Selector on the Amplifier rear panel to the 115V position.

i. With the ohmmeter still connected to the line cord, set front panel power switch to the off position. The ohmmeter should indicate an open circuit. If not, locate the short circuit path, and correct the defect.

j. Connect the ohmmeter probes between one of the flat terminals and the round terminal of the line plug.

k. Set the POWER switch to the ON position. The meter should indicate an open circuit.

l. Similarly measure the resistance between the other flat terminal and the round terminal. The meter should indicate an open circuit.

m. Set the Simpson 260 meter controls to the +DC and Rx1 position, and zero the meter.

n. Using the ohmmeter, check the resistance of the diode bridge as follows. Connect the common (-) probe of the meter to the diode terminal soldered to the red harness wire. Using the (+) probe of the meter, measure the resistance of the two diode terminals soldered to orange harness wires. The correct indication is approximately 10 ohms.

o. Reverse the polarity of the ohmmeter and repeat the measurement. An indication of almost infinity should be obtained on the Rx1 scale.

p. Connect the common (-) meter probe to the diode terminal soldered to the yellow wire. Using the (+) probe, measure the resistances on the two diode terminals soldered to orange wires. An indication of almost infinity should be obtained on the Rx1 scale.

q. Reverse the polarity of the ohmmeter and repeat the above measurements. The correct indication is approximately 10 ohms.

CAUTION

If the diode measurements are outside the prescribed limits, replace the diode or locate the problem before proceeding with the test.

r. Replace all covers except top cover.

s. Plug in line cord, with the POWER switch off.

t. Connect ground lead of a dc voltmeter to the chassis.

u. Place the dc probe of the voltmeter in contact with the "feedthrough" terminal in the center partition. (See figure 5-4.)

v. Set the Amplifier POWER switch to the ON position, and quickly check that the following occurs:

(1) Power switch illuminates.

(2) Fan motor runs.

(3) Voltmeter indicates approximately +28V; (adjust R2 on the power supply board if necessary).

CAUTION

Set the POWER switch to the off position if any of the above conditions are not met. If the dc voltage indication is less than 25 vdc, perform the power supply adjustment procedure in section 5.3.7.

w. Set the POWER switch to the off position.

5.3.4 RF CHECK AND ALIGNMENT

a. Connect a 50-ohm, 20 watt RF dummy load and an HP-410B voltmeter to the OUTPUT connector, using a BNC "T" fitting as shown in figure 5-1. Use less than 3 feet of cable between the Amplifier and the load to minimize VSWR effects.

b. Connect an RF signal generator and an RF voltmeter to the Amplifier input, using a "T" fitting attached directly to the Amplifier INPUT connector to minimize cable loss errors affecting the meter readings.

c. Adjust the RF signal generator for a 50 kHz, 50 mv output, as measured by the voltmeter connected to input of the Amplifier.

d. Set the HP-410B to the 30 vac range.

e. Set the Amplifier METER RANGE switch to the HI position.

f. Set the Amplifier POWER switch to the ON position.

g. Adjust the level of the input signal until the HP-410B voltmeter at the load indicates 20 Vrms.

h. Observe and record the level of the input voltage as indicated by the Boonton 91H voltmeter at the input connector of the Amplifier. (This particular recorded indication shall hereinafter be referred to as "Vin".) The magnitude of "Vin" should be between 65 and 80 mv. If "Vin" does not fall within these limits there is a malfunction in either the input cabling, or the Amplifier assembly (A4, A5, A8).

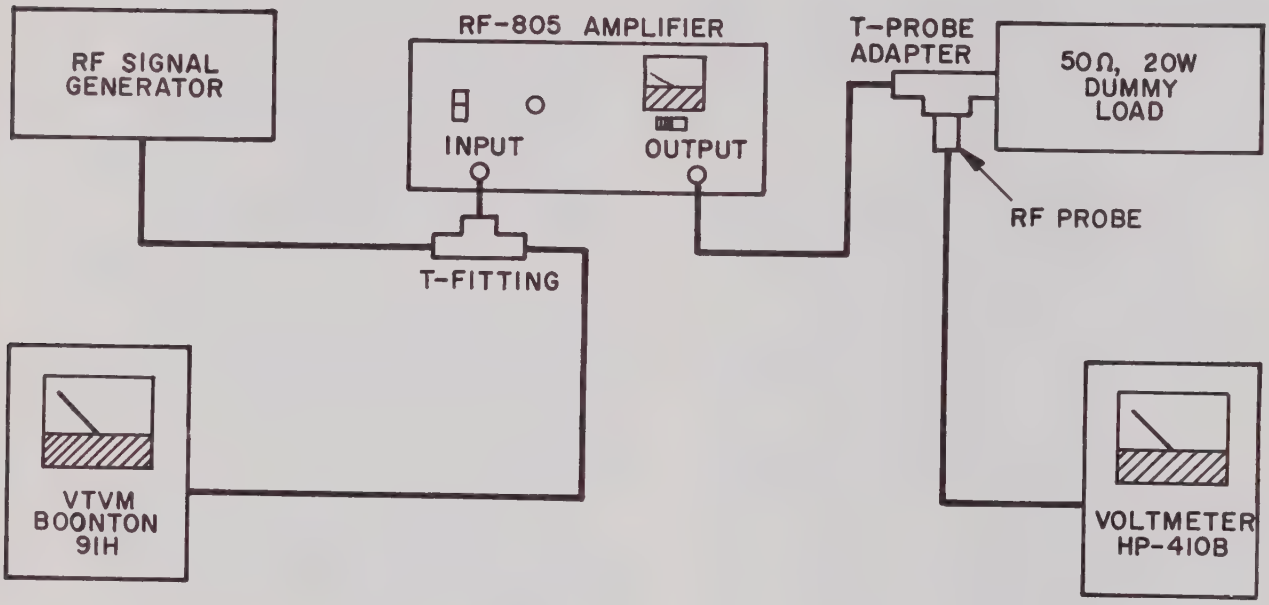


Figure 5-1. Amplifier Test Setup.

i. Adjust the RF signal generator for an 80 MHz signal of amplitude equal to "Vin" as indicated by the input meter.

j. The HP-410B voltmeter should indicate 20 ± 1 Vrms.

NOTE

The 80 MHz gain of the amplifier may be adjusted with trimmer capacitor A4C9. See figures 5-4 and 5-6. Access to A4C9 is obtainable through the perforations in the center vertical partition of the Amplifier. Use an insulated tuning tool to adjust capacitor A4C9.

k. Measure and record the output voltage of the Amplifier at 10 MHz, 30 MHz, 40 MHz, and 80 MHz, while keeping the input amplitude constant at "Vin".

l. Keeping the input voltage constant at "Vin", sweep a range of from 30 MHz to 80 MHz, and record the highest output voltage, "V peak" and the frequency at which it occurs, "F peak".

m. Review all the indications recorded in the last two steps. The difference between the high and low voltage readings should be less than 4.6 Vrms. Readjust trimmer capacitor A4C9 if necessary.

5.3.5 METER ADJUSTMENT.

a. Perform steps a through g of the RF Check and Alignment Procedure, section 5.3.4.

b. With 20 Vrms appearing at the 50-ohm load, the front panel meter should indicate 20 ± 0.6 Vrms. If not, slide the top cover of the Amplifier back and adjust

potentiometer A7R3 on the Meter Circuit Board for an indication of exactly 20 Vrms. See figures 5-4 and 5-10.

NOTE

This procedure calibrates the front panel meter against the external output test meter. Be sure that the test meter is calibrated and that it is flat between 50 kHz and 80 MHz.

c. Adjust the RF signal generator for an Amplifier output of 20 Vrms at 80 MHz as indicated on the HP-410B output test meter.

d. Observe the front panel meter indication and readjust potentiometer A7R3 until the amount of error at 80 MHz is reduced by one-half. Record the front panel meter indication. The front panel meter should then read 20 $\pm$ 0.6 Vrms, excluding errors of the calibrating meter.

e. Adjust the RF signal generator for an Amplifier output indication of 7 Vrms at 50 kHz, as indicated on the output test meter.

f. Set the METER RANGE switch on the front panel to the LO position.

g. The front panel meter should indicate 7 Vrms. If not, slide the top cover back and adjust potentiometer A7R8 on the Meter Circuit Board for an indication of exactly 7 Vrms. See figures 5-4 and 5-10.

h. Adjust the RF signal generator for Amplifier output of 7 Vrms at 80 MHz, as indicated by the HP-410B voltmeter at the Amplifier output.

i. Observe the front panel meter indication, and readjust potentiometer A7R8 until the amount of error at 80 MHz is reduced by one-half. The front panel meter should then read 7 $\pm$ 0.2 Vrms, excluding errors of the calibrating meter.

5.3.6 OVERDRIVE ADJUSTMENT.

a. Perform steps a through f of the RF check and Alignment Procedure, section 5.3.4.

b. Disconnect coax from A3E1 and A3E2 on overdrive circuit board.

c. Slowly increase the RF signal generator amplitude until 100 mv is indicated on the input voltmeter. The overdrive indicator may illuminate.

d. Potentiometers A3R11 and A3R20 on the overdrive circuit board provide coarse and fine control of the overdrive threshold, respectively. See figures 5-4 and 5-9. Adjust these potentiometers so that the indicator just goes out.

e. Adjust the RF signal generator for an 80 MHz, 20 Vrms indication, on the HP-410B voltmeter at the output of the amplifier.

f. Reconnect coax to terminals A3E1 and A3E2 with coax shield to A3E2.

g. Slowly increase the amplitude of the input signal while observing, the output voltage and the overdrive indicator lamp. The maximum obtainable 80 MHz output voltage should be between 23 Vrms and 28 Vrms. Readjust potentiometer A3R20 if necessary, and then repeat the 50 kHz measurement.

5.3.7 POWER SUPPLY ADJUSTMENT.

Perform the following procedure after replacement of a power supply subassembly (A1 or A2) or if the power supply voltage is abnormal.

a. Check that the line cord is disconnected and that the POWER switch is in the off position.

b. Slide back the top cover of the Amplifier to expose the +28 Vdc feed-through connector on the center partition of the Amplifier. See figure 5-4.

c. Carefully unsolder the jumper wire connecting the Amplifier Assembly to this feedthrough terminal (rear side of center partition).

d. Connect an external 28 volt, 3.5 amp load between the feedthrough terminal and the Amplifier chassis. An 8 ohm, 150 watt resistor or rheostat may be used.

e. Set potentiometer A1R7 on the power supply A1 Regulator PC Board fully counter-clockwise. See figures 5-4 and 5-8.

f. Connect the line cord, and set the POWER switch to the ON position.

g. Using a Simpson 260 voltmeter, measure the dc voltage between pins E1 (+) and E4 (-) on Regulator Board A1. If the indicated voltage is below 35 vdc, the trouble is probably in rectifier CR1 and its associated circuitry (refer to schematic figure 6-2). If the indication is from +35V to +50 vdc, proceed to step h.

CAUTION

Pin E1 is nominally +28 Vdc above chassis ground and pin E4 is nominally -12 Vdc with respect to ground. USE ONLY ISOLATED COMMON LINE VOLTMETERS FOR THIS MEASUREMENT.

h. Using the dc voltmeter, measure the voltage between the feedthrough terminal (step c) and ground. Adjust potentiometer A1R2 on the A1 Regulator Printed Circuit Board for an indication of +28 vdc. If a correct indication cannot be obtained, remove the Power Supply (A1, A2) assembly and check for a defective component. Refer to the schematic diagram figure 6-2.

i. After A1R2 has been adjusted for a supply voltage of +28 vdc, adjust potentiometer A1R7 slowly clockwise until it is mid-range or until the power supply indication just starts to fall. (This potentiometer adjusts the current limit of the power supply.) If the output voltage starts to fall with the adjustment of A1R7, back off slightly to be sure that the supply is not current limiting.

j. Using an oscilloscope with a high gain pre-amplifier, check that the ripple on the supply is less than 20 mv peak-to-peak.

k. If all of the above steps have been successfully completed, turn off the Amplifier and reconnect the jumper wire between the feed-through terminal (step c) and the Amplifier Assembly.

l. With the power supply connected and monitored with a dc voltmeter, energize the Amplifier. An indication of +28 $\pm$ 1 vdc should be indicated. If not, the problem is probably in the Amplifier Assembly.

5.3.8 AMPLIFIER ASSEMBLY BIAS ADJUSTMENT.

The following procedure is required to adjust the bias point of the final output transistors. The procedure may also be used as an aid in troubleshooting if a trouble in the Amplifier Assembly is suspected.

a. Carefully remove the Amplifier Assembly from the chassis by following the disassembly procedure of section 5.5.4.

b. Connect an HP-410B voltmeter and a 50-ohm, 20 watt load to the A6 trans-

former output cable (figure 5-5).

c. Direct air from a blower on the Amplifier Assembly, so that the air passes over the heatsink as well as the printed circuit board. A 5 inch Muffin fan placed from 6 to 12 inches away from the end of the assembly will do.

d. Adjust power supply to deliver +28 vdc and current limit at 3.5 amps. De-energize the supply.

e. Connect the positive lead of the power supply to the +28 volt input lead of the Amplifier Assembly, and connect the supply return to the heatsink. (see figure 5-6.)

f. Energize the power supply while monitoring the supply voltage and current.

CAUTION

If there is any indication of current limiting, immediately remove the supply voltage and attempt to determine the cause. Refer to the schematic diagram, figure 6-1.

g. With the HP-410B voltmeter connected to the output load, check that there is no evidence of an rf signal at the output, due to either noise or oscillation.

h. Connect the ground lead of the HP-410B voltmeter to the heatsink, and using the dc probe, VERY CAREFULLY measure the voltage at test points TP1 through TP4 on Output Transistor Board A8. See figure 5-6. The voltage at these test points should be from 1.05 to 1.15 vdc.

CAUTION

The test points are connected to the output transistor emitter resistors, which protect the transistors against excessive current. Be very careful not to accidentally ground these test points, since all the transistors on the assembly would have to be replaced if damage occurs.

i. Potentiometer R4 (figure 5-7) controls the bias of the output transistors. When the A4 Preamplifier and Driver Printed Circuit Board is mounted on the heatsink, access to R4 is provided by a small hole located between the center fins of the heatsink, directly beneath R4. Using a small screw driver adjust potentiometer R4 for a nominal indication of 1.1 vdc on test points TP1 through TP4. The voltage on all the test points should fall between 1.05 and 1.15 vdc.

j. Re-install the Amplifier Assembly in the chassis.

5.3.9 SELECTION OF CAPACITORS A4C29 & C30.

Capacitors A4C29 and C30 balance the high frequency differential output of the A4 Preamplifier and Driver Printed Circuit Board. These capacitors compensate both for variations in printed circuit board output characteristics and output Amplifier transistor input impedance. If either assembly A8 or A4 is changed, capacitors C29 and C30 may need to be changed to obtain optimum harmonic supression for the overall amplifier. These capacitors are chosen from values of 33 pf, 47 pf, and 68 pf.

If, after replacing either the A4 or A8 assembly, the harmonic output of the amplifier exceeds the specification level, perform the following procedure.

a. Using a frequency selective voltmeter, plot the second and third harmonic response of the amplifier.

NOTE

For the above measurements, the harmonic components of the signal source must be at least 40 db below the fundamental.

b. After reviewing the above data, select the fundamental frequency which yielded the worst indication greater than 30 db below the fundamental for either second or third harmonic.

c. Temporarily connect a 47 pf capacitor from pin 6 on the A4 printed circuit board to ground, and recheck the worst case determined in step b.

d. If the measurement of step c shows an improvement over that of step b, change the value of C29 first to 33 pf and then to 68 pf, measuring the entire harmonic response for each value of C29 in order to pick the optimum value. If the measurement in step c is worse than that of step b, place the capacitor on pin 5, and repeat the above procedure.

e. When the optimum value has been chosen in step d, and further improvement is required, place a 33 pf capacitor on the opposite capacitor position and repeat the selection procedure of the previous step until the optimum capacitor is selected for both C29 and C30.

5.4 TROUBLESHOOTING.

The first step in isolating a trouble is to review the conditions under which the symptoms were observed and check that trouble is not caused by the external hook-up or associated equipment. Observe the front panel meter, OVERDRIVE indicator, POWER switch and fuse, and note any details which might help locate the trouble.

Some commonly found symptoms together with instructions as to "probable cause" and "recommendations" are listed in the Troubleshooting Guide table 5-1. Frequent reference is made, in this table, to sections of the preceeding Amplifier Performance Test and Alignment Procedures. If the observed symptom is not listed in table 5-1, perform the entire procedure of section 5-3. Refer to the schematic diagrams, figures 6-1 and 6-2 for dc and ac voltage measurements.

TABLE 5-1. TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
Blown Fuse	Incorrect fuse value	Check for proper fuse.
	Defective line filter FL1 or diode rectifier bridge CR1, or frayed harness wire.	Perform steps a - q in section 5.3.3.
Low RF Output Voltage for Specified Input Signal.		
Case 1: OVERDRIVE light, off; input frequency = 1 MHz	Internal input cable open or shorted.	Ohmmeter check (The cable is terminated with parallel silicon diodes connected back to back. Refer to schematic diagram figure 6-1.) Both polarities of ohmmeter should indicate 10±3 ohms. If indication is incorrect, attempt to locate trouble with ohmmeter and replace the defective component.
	Meter circuit diodes shorted.	Check OUTPUT connector with ohmmeter. Should be about 47K ohms - both polarities. If output resistance is low, unplug jumper wire connecting the center pin of the output coax connected to the Meter Circuit PCB A7, and repeat ohmmeter check. Replace the Meter Circuit PCB if indicated. NOTE The most probable cause of meter board failure is EXCESSIVE voltage FED BACK to the output connector of the Amplifier. Check for system instability and load device before re-installing Amplifier.

TABLE 5-1. TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
	115/230 Volt line switch in the wrong position.	Check for correct position of line switch.
	Defective Power Supply	Perform steps s - v of section 5.3.3.
	Defective Amplifier Assy.	Perform Amplifier Assembly Bias Adjustment procedure, section 5.3.8.
	Heatsink thermostat switch open.	a. Check for proper operation of fan and that the air filter is clean and unobstructed. b. Perform Amplifier Assembly Bias Adjustment Procedure section 5.3.8.
Low RF Output Voltage for Specified Input Signal.		
Case 2: Overdrive light on; input frequency = 1 MHz	Internal output cable open.	Visually inspect cable attached to OUTPUT connector, and look for breaks in the shield or center conductor connections.
	Defective overdrive circuit.	a. Visually check all connections to the Overdrive Amplifier PCB. See figure 5-9 and table 5-2. b. Remove green wire attached to pin E7 on the overdrive board and recheck for proper Amplifier output. CAUTION Removing the green wire on the overdrive board, disables the protection circuits. DO NOT EXCEED 100 MV RMS INPUT VOLTAGE; TERMINATE AMPLIFIER IN 50 OHMS.

TABLE 5-1. TROUBLESHOOTING GUIDE (Cont)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
		If proper output indication is obtained, then replace Overdrive Amplifier PCB. NOTE Do not use Amplifier without a functioning Overdrive board installed without obtaining special instructions from the factory.
	Defective Amplifier Assy.	Perform Amplifier Assembly Bias Adjustment, section 5.3.8.
DC Voltage on OUTPUT Connector	Defective output transformer.	Replace output transformer A6.
Incorrect Panel Meter Indication	Improper calibration of the meter.	Perform Meter Adjustment Procedure section 5.3.5.
	Defective meter.	The front panel meter has a 100 uA movement. A defective meter can be found by substituting a laboratory meter.
	Defective meter board.	Remove Meter Circuit board, and check each component with an ohmmeter. Replace defective component.
	High level harmonic content of signal.	The amplifier meter circuit is an AVERAGE reading meter, calibrated in RMS volts. If the signal has high harmonic content, a peak reading meter, such as a Hewlett Packard model 410B, will have a different indication from that of the front panel meter. The

TABLE 5-1. TROUBLESHOOTING GUIDE (Cont)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATION
		amount of discrepancy will depend upon the magnitude and phase of the harmonic components. If the input signal harmonics are known to be better than -40 db down from the fundamental, check the output of the Amplifier with a sampling oscilloscope, and check for signal distortion. If distortion is noted, perform the Amplifier Assy test procedures, sections 5.3.4, 5.3.8, and 5.3.9.

5.5 DISASSEMBLY PROCEDURES.

5.5.1 GENERAL.

The following disassembly procedures describe the recommended method of removing subassemblies and printed circuit boards for the purpose of test, repair, or replacement. Careful handling should be used to avoid damaging the boards.

5.5.2 TOOLS REQUIRED.

The RF-805 Amplifier is assembled with standard hardware with screw sizes ranging from 4-40 to 8-32. All screw heads are of the "philips" or slotted types. The only special tools recommended are:

a. No. 1, 8 in. philips-head screw driver.

b. Torque wrench capable of limiting at 15 in-lbs.

The 8 inch philips-head screw driver will facilitate disassembly where screw access requires lateral penetration of the chassis. The torque wrench should be used to limit the torque on stud mounted semiconductor hardware.

5.5.3 REMOVAL OF COVERS.

Each of the four covers of the RF-805 Amplifier is retained by two screws located on the folded over portion of the cover, adjacent to the rear panel. See figure 5-2. To remove either the top or bottom cover, remove the associated retaining screws, and slide the cover straight back. In order to remove the side covers, the top and bottom covers must first be removed.

To replace a cover, carefully align the cover with its retaining guide, and slide it forward toward the front panel. Be sure that the leading edge of the cover is guided

underneath the lip of the front panel. The side covers must be installed before the top and bottom covers.

CAUTION

As the covers are replaced, be sure that the rear panel tinnerman fasteners are enclosed by the folded over portion of the cover as it is seated. Damage to both the fastener and to the cover can result if the cover is forced on without observing the above precaution.

5.5.4 AMPLIFIER ASSEMBLY A4,A5, A8.

The following procedure for the removal of the Amplifier Assembly applies to serial no. 292 and later units. Information pertaining to prior units is contained in a supplement, which is available to owners of these units.

a. Remove all four covers (see section 5.5.3).

b. Set the Amplifier on its handles so that the front panel is parallel to the table.

c. Remove the four Amplifier Assembly retaining screws. Refer to figures 5-3 and 5-4.

d. Unsolder jumper wire from +28V feedthrough (see figure 5-4) and the Amplifier Assembly.

e. Unplug the green wire and the shielded cable routed to the A3 Overdrive Amplifier printed circuit board.

f. Unplug the input, output, and overdrive cables shown in figures 5-3 and 5-5.

g. Carefully slide the Amplifier Assembly out of the right side of the chassis.

CAUTION

When removing the Amplifier Assembly, check that the four coaxial lines connected to the assembly do not snag on the chassis.

5.5.5 PREAMPLIFIER AND DRIVER PC BOARD A4.

a. Unsolder capacitors C1 and C2 and detach them from pins A4E6 and A4E5 respectively. See figure 5-6.

b. Remove the +28 vdc connector from pin A4E10.

c. Remove the four printed circuit board retaining screws.

d. Unsolder the ground strap connecting the A8 and A4 assemblies.

e. Carefully remove the printed circuit board.

NOTE

When the printed circuit board mounting screws are removed, the four 5/8 inch spacers will fall from the assembly. They should be tagged and stored for use in reassembly.

NOTE

After replacing the assembly, adjustment is necessary to obtain full harmonic suppression. Refer to section 5.3.9.

5.5.6 OUTPUT TRANSISTOR ASSEMBLY A8.

5.5.6.1 Removal. The six transistors comprising the Output Power Amplifier stage are matched at the factory. In the event that one of these transistors is found to be defective, the entire Output Transistor Assembly A8 should be removed and returned to the factory for repair or replacement. To remove this assembly, perform the following procedures:

a. Carefully unsolder the small rigid coaxial cables D1 and D2 from Output Transformer A6. (Refer to figure 5-7.)

b. Unsolder and detach the following items from the A8 assembly: capacitor A5C3 (figure 5-6), overdrive cable (figure 5-7), R6 base bias wire (figure 5-7), wires from resistors A5R5 and A5R7 (figure 5-7), and ground strap from front of assembly to ground lug on heatsink.

c. Remove the six nuts from the studs of the output transistors.

d. Lift the Output Transistor Assembly A8 straight up from the heatsink.

NOTE

When lifting the output transistor assembly from the heatsink some difficulty may be encountered due to a liquid locking material used to anchor the transistor mounting nuts on some units. If this difficulty arises, carefully tap the transistor studs with a small plastic mallet. In the event that the output transistor assembly cannot be removed without damage, return complete heatsink assembly to factory.

e. Replace nuts on transistor studs for safe keeping.

NOTE

If the A8 Assembly is to be returned to the factory, mount the Assembly on a sturdy cardboard partition using the transistor studs and nuts. Using strong industrial packing tape, attach the cardboard securely to the sides of a small box such that no part of the assembly comes in contact with the box. The small box should then be placed in a larger shipping container with foam rubber or other suitable packing material between the small box and the shipping container.

5.5.6.2 Replacement.

a. Thoroughly clean the mounting surfaces of the output transistors and the heatsink assembly area adjacent to the mounting holes.

b. Apply a thin coating of silicon grease to the mating surfaces of the transistors and the heatsink.

CAUTION

Particles trapped between the transistor and the heatsink can seriously increase the thermal impedance of the junction and cause destructive overheating of the transistor.

c. Lower the Output Transistor Assembly A8 onto the heatsink. Capacitor A8C8 should be oriented as shown in figure 5-7.

d. Replace the nuts on the output transistors and tighten to 15 in-lbs with a torque wrench.

e. Reattach and resolder items removed in paragraph 5.5.6.1, step b.

NOTE

After replacing the assembly, adjustment may be necessary to obtain full harmonic suppression. Refer to section 5.3.9.

5.5.7 OUTPUT TRANSFORMER.

5.5.7.1 Removal.

a. Unsolder the transformer input connection from solid coaxial cables D1 and D2. See figure 5-7.

CAUTION

The UT25 cables are extremely fragile and difficult to replace. Use extreme care when handling them or associated components. If they should break, refer to section 5.5.8 for replacement procedure.

b. Unsolder and detach resistor A5R32.

c. Unsolder the ground lug from the transformer output cable.

d. Remove the two mounting screws and lift the transformer off the Heatsink Assembly.

5.5.7.2 Replacement. The replacement of the Output Transformer is the reverse of the removal procedure.

5.5.8 UT25 COAX CABLE.

To replace the UT25 coaxial cable, perform the following procedure.

a. Remove the Preamplifier and Driver Assembly A4 and the Output Transistor Assembly A6, as per the procedures in section 5.5.6 and 5.5.7.

b. Using a pair of diagonal cutters, clip the UT25 cable to be removed as close as possible to the underside of the Emitter Ground Board shown in figure 5-7.

c. Melt the solder where the UT25 cable penetrates the Emitter Ground Board, and gently extract the free portion of the cable.

d. Similarly remove the short section of coax attached to the Output Transistor board, A8.

e. Using flux and appropriate "solder-sucking" tools, carefully clean the two holes vacated by the cable.

f. Cut a new 2 in. section of UT25 cable.

g. Strip the copper jacket back from both ends, a distance of 1/4 inch.

NOTE

To strip the cable, use a pair of needle-nose pliers to sharply bend the coax at right angles, first one way and then the opposite way. This should break the cable jacket at the flex point, and the end portion may then be slipped off the center conductor. (Practice on a sample piece before attempting to replace a cable.)

h. Insert the coax through the Emitter Ground Board and into the larger component board of the A8 assembly.

i. Re-solder the cable at both boards.

j. Using a round-jawed pair of needle-nose pliers, contour the UT25 to match the original.

CAUTION

The UT25 cable should be bent carefully over a round forming tool. A sharp bend will crack the shield or ruin the cable.

k. Replace Output Transistor Assembly A8 and the Preamplifier and Driver Assembly A4.

5.5.9 POWER SUPPLY ASSEMBLY

5.5.9.1 Assembly Removal and Replacement. To remove the Power Supply Assembly from the chassis, unplug the red and yellow wires from pin E1 and E4, respectively, of Regulator Board A1. See figures 5-4 and 5-8. Then remove the two screws which secure the Power Supply Assembly to the chassis (accessible from the bottom of the chassis), and remove the Power Supply Assembly. Replacement is the reverse of the removal procedure.

5.5.9.2 Regulator A1 Board. To remove Regulator Board A1 from the Power Supply Assembly, first remove all wires from pins E1 through E4. Unscrew the four board retaining screws, and remove the A1 Regulator Board.

When replacing the Regulator Board connect the three wires from the heatsink as follows:

Green	E3
Yellow	E5
Black	E2

5.5.10 FRONT PANEL ASSEMBLY

To remove the front panel assembly, unscrew the four retaining screws located in the handles of the equipment. On units prior to serial number 271, these screws are covered by the vinyl strips on the handles. Access to the screws may be obtained by carefully peeling back the vinyl strips with a sharp knife or blade to uncover the screws.

The Front Panel Assembly to chassis wires must be disconnected before the front panel may be removed. Some wires are connected by individual pins and sockets, while others are soldered. Table 5-2 lists all the connecting wires and associated terminations.

CAUTION

When removing the front panel, avoid putting a strain on the interconnecting wires. The pin connectors can be damaged by tension perpendicular to the direction of the pin.

5.5.11 OVERDRIVE AMPLIFIER BOARD A3.

The Overdrive Amplifier Board may be replaced without removing the Front Panel Assembly. To remove the board, perform the following procedure. Replacement is the opposite of the removal procedure. Refer to table 5-2 for wiring data.

a. Disconnect all wires connected to the A3 board.

b. Remove the two retaining nuts near the top corners of the A3 board. See figure 5-9.

c. Gently pull the top of the A3 board away from the front panel such that the two retaining studs disengage.

NOTE

The bottom of the board is held by two slots in the A3 board, which are

seated in rubber retainers attached to the front panel. Do not unscrew these retainers.

d. After the board has been tilted away from the front panel, lift the board straight up and out of the equipment.

5.5.12 AIR FILTER

The air filter may be removed as follows:

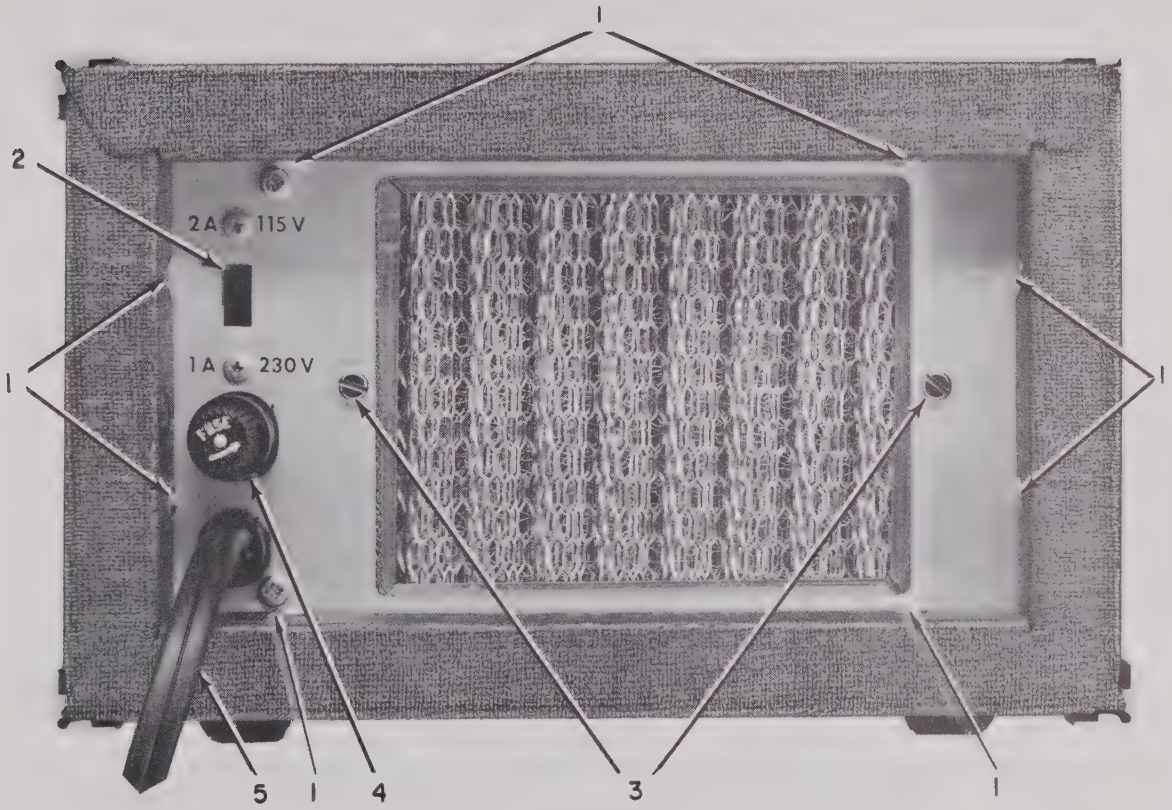
a. Remove top cover (see section 5.5.3).

b. Remove the two air filter retaining screws (see figure 5-2).

c. Lift the filter straight up and out of the Amplifier.

TABLE 5-2. FRONT PANEL TO CHASSIS WIRING

FROM	WIRE DESCRIPTION	TO	CONNECTION TYPE
A3 (Overdrive) Pin 3	Coax from top left of frame: center cond.	Amplifier Assy.	Pin Connector
A3 Pin 4	shield	Amplifier Assy.	Pin Connector
A3 Pin 1	Coax from top right of frame: center cond.	Amplifier Assy.	Pin Connector
A3 Pin 2	shield	Amplifier Assy.	Pin Connector
A3 Pin 5	Red wire	Overdrive lamp and harness	Pin Connector
A3 Pin 6	Orange wire	Overdrive lamp and harness	Pin Connector
A3 Pin 7	Green wire	Amplifier Assy.	Pin Connector
Overdrive Lamp:			
Left Pin	Two red wires	Harness and A3	Solder
Right Pin	Orange wire	Harness and A3	Solder
OUTPUT connector:			
Center terminal	Yellow wire	A7 Pin 8	Pin Connector
Ground lug	Yellow/white wire	A7 Pin 7	Pin Connector
Meter switch	Green wire	A7 Pin 1	Pin Connector
	Green/white wire	A7 Pin 2	Pin Connector
	Blue/white wire	A7 Pin 4	Pin Connector
	Blue wire	A7 Pin 3	Pin Connector
INPUT Connector	Coax, left bottom frame	Amplifier Assy.	Solder
OUTPUT Connector	Coax, right top frame	Amplifier Assy.	Solder
POWER Switch (sketch before removing)	Brown, brown/white, and grey wires	Harness	Solder



1 - COVER RETAINING SCREWS
2 - 115/230 V LINE SELECTOR, S2
3 - AIR FILTER RETAINING SCREWS
4 - FUSEHOLDER, XF1
5 - LINE CORD

Figure 5-2. Rear Panel, Component Locations

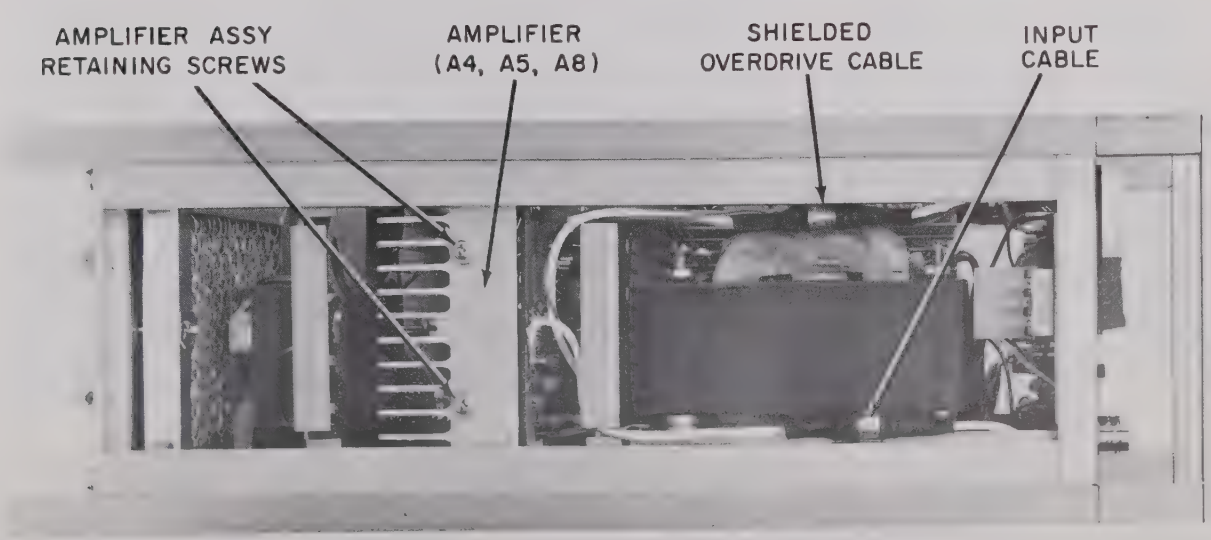


Figure 5-3. Left Side, Component Locations

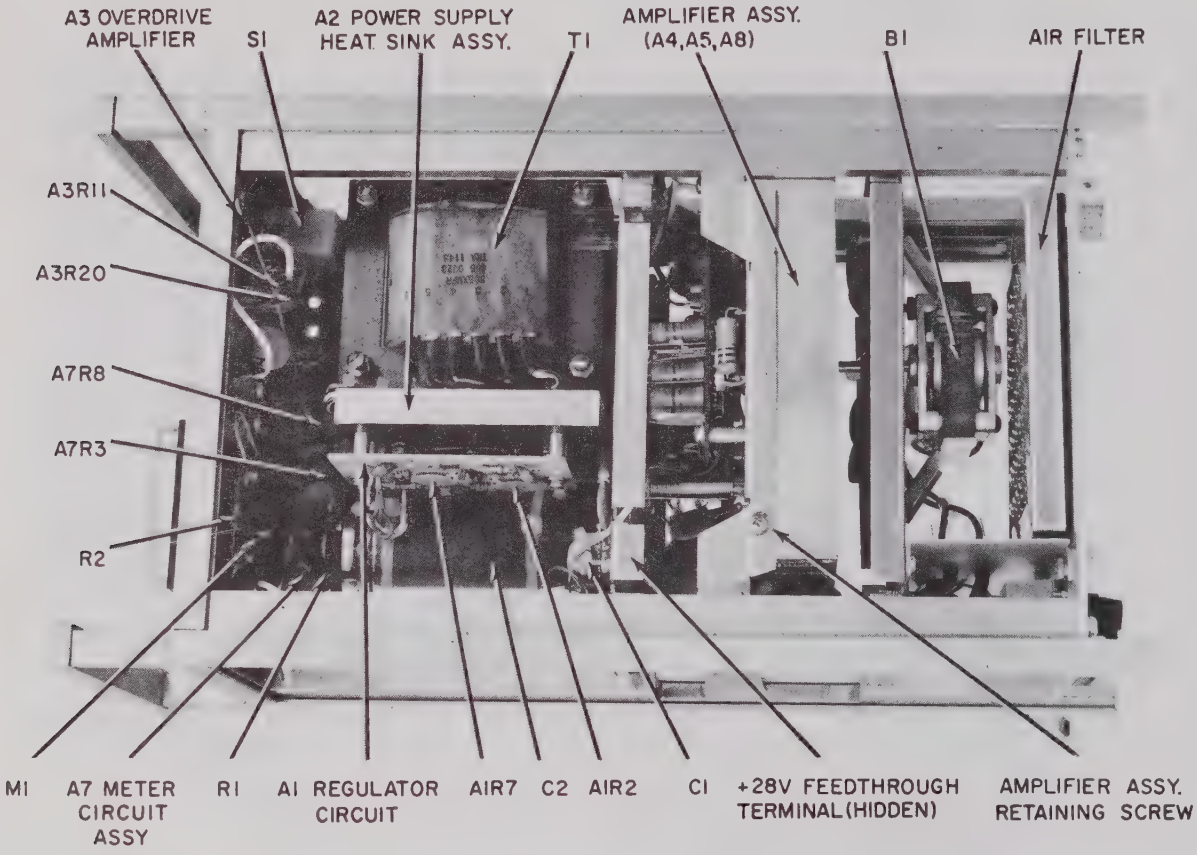


Figure 5-4. Top View, Component Locations

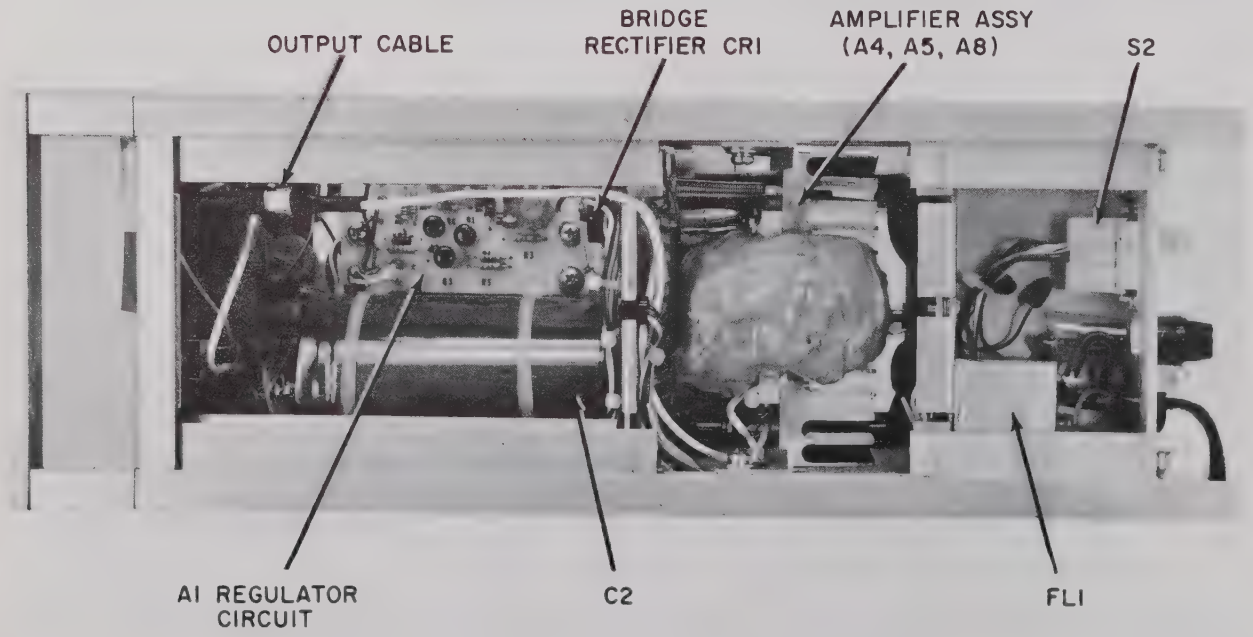


Figure 5-5. Right Side, Component Locations

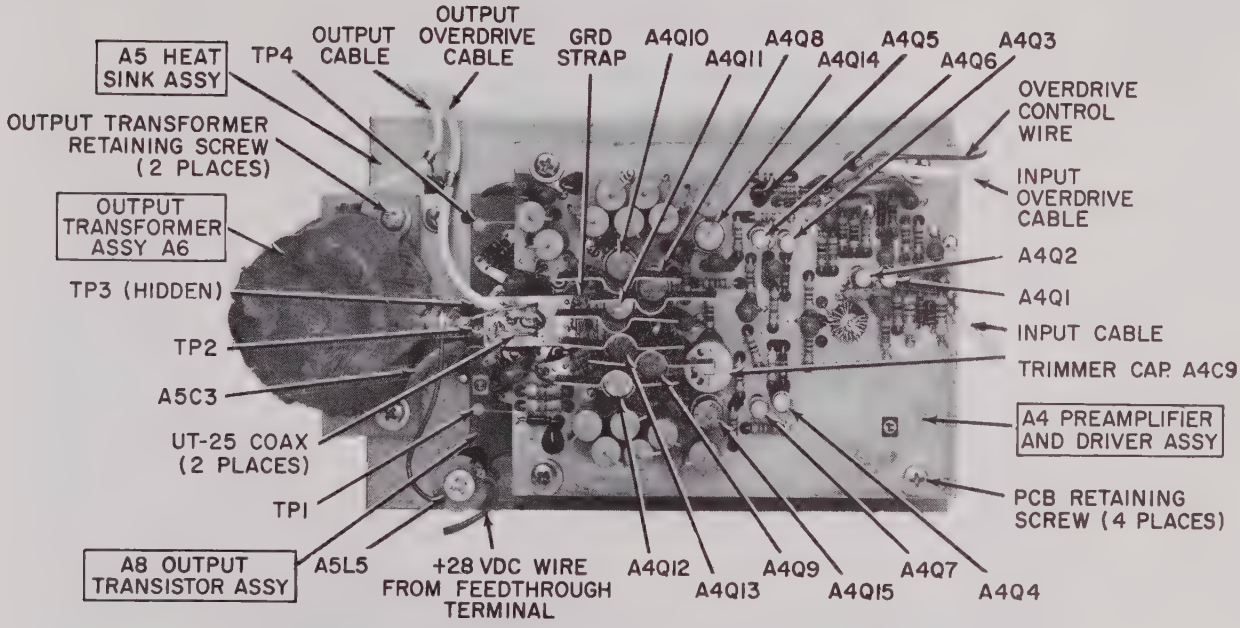


Figure 5-6. Amplifier Assembly, Component Locations

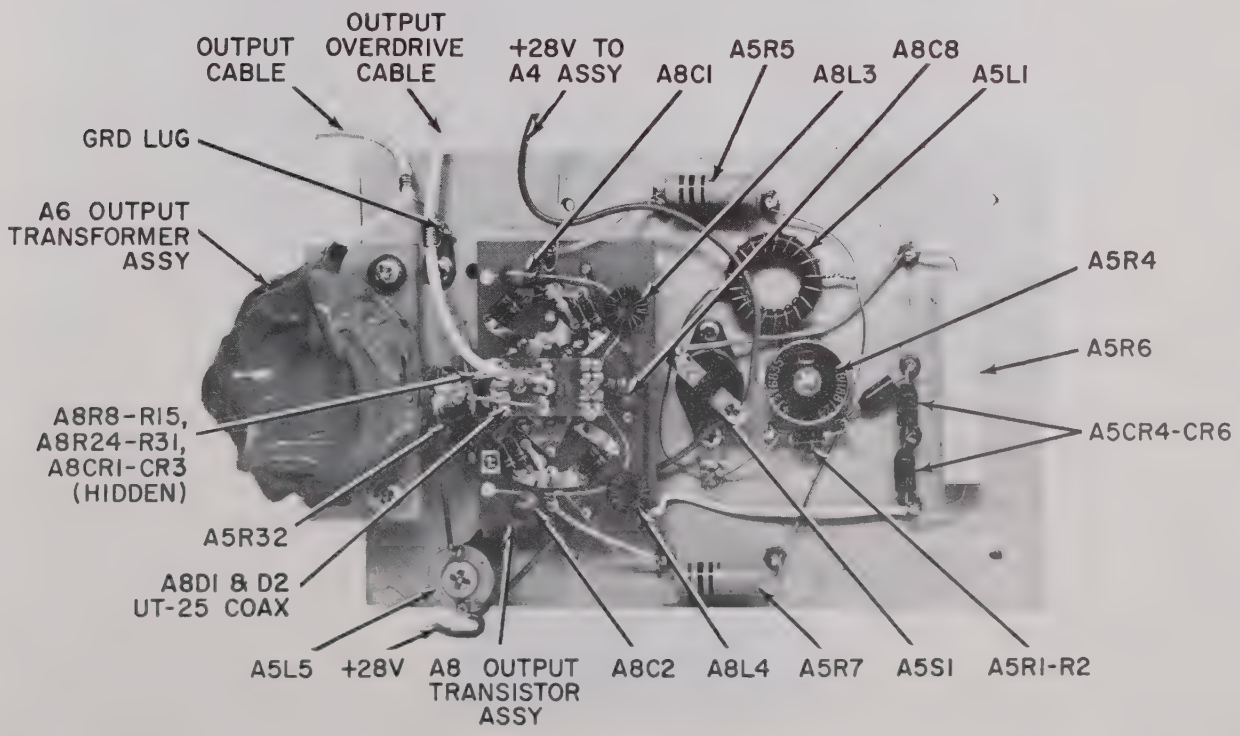


Figure 5-7. Heatsink Assembly A5 and Output Transistor Assembly A8, Component Locations

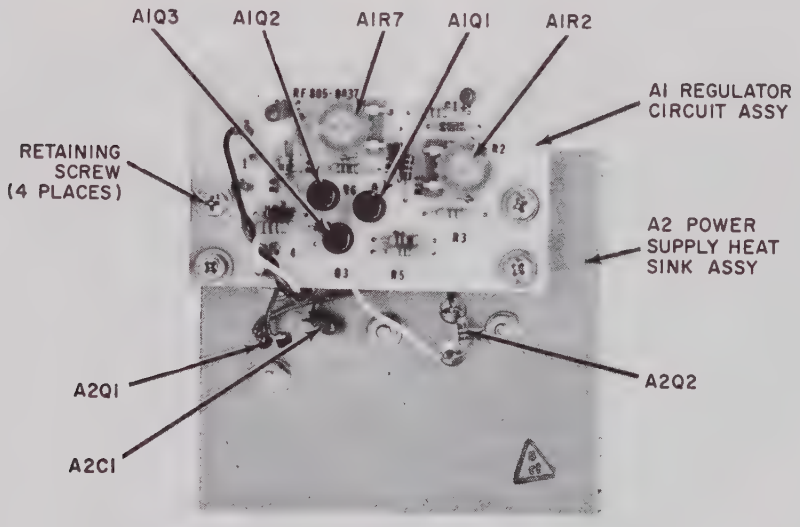


Figure 5-8. Power Supply Assembly Component Locations

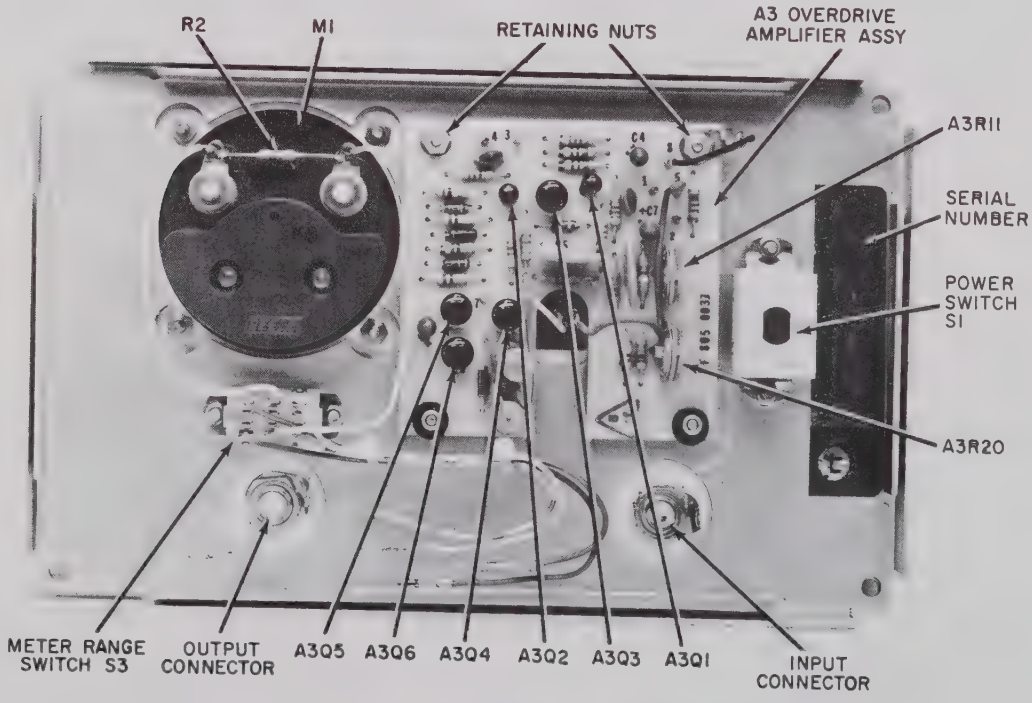


Figure 5-9. Back of Front Panel, Component Locations

Figure 5-10. Meter Circuit Assembly A7, Component Locations

CHAPTER 6
PARTS LIST AND SCHEMATICS

6.1 PARTS LIST.

Table 6-1 provides a listing of all electrical parts and those mechanical parts which might be required for replacement purposes. Electrical parts are listed by assembly and in alpha-numeric order of reference designations as marked on the schematic diagrams. Listings include a description of the part, the part number, and a manufacturer code number. Table 6-2 provides a reference glossary of abbreviations used in the parts list. Table 6-3 lists the assemblies used in the instrument with corresponding assembly reference designation prefixes.

6.2 LIST OF MANUFACTURERS.

Table 6-4 provides a correlation of the manufacturer code numbers used in the parts list with the names and addresses of the typical manufacturers. If RF Communications' manufacturer code number (14304) appears, that part must be obtained directly from RF Communications, Inc. Otherwise, the part optionally may be obtained from your local parts distributor.

6.3 ORDERING REPLACEMENT PARTS.

To obtain replacement parts, address order or inquiry to your local RF Communications, Inc. representative. Identify parts by the part number and the manufacturer code number as listed in the parts list.

To obtain a part which is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6.4 SCHEMATIC DIAGRAMS.

Complete schematic diagrams for the instrument appear in figures 6-1 and 6-2. Refer to table 6-3 for assembly breakdown used on schematic diagrams.

TABLE 6-1. REPLACEMENT PARTS LIST.

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
	CHASSIS MOUNTED PARTS (NO PREFIX):		
B1	MOTOR, FAN	14304	BX158051
---	BLADE, FAN	14304	BX208051
C1	CAP, FILM, 0.47 UF, 200 VDCW	73445	C296-AB A470K
C2	CAP, ELECT, 15000 UF, 50 VDCW	14304	CX02183051
C3	CAP, CER, 0.1 UF, +80-20%, 100 VDCW, 0.7 IN. DIA, SINGLE DISC	91418	TA
C4	CAP, CER, 6.8 PF, 5%, NPO, 500 VDCW	91418	CG
CR1	RECTIFIER, SIL. DIODE BRIDGE	14304	CR208051
DS1	LAMP, INCAND, 2.7 VDC, 60 MA, RED	14304	DS05227060
F1	FUSE, QUICK-ACTING, TYPE 3AG:		
	FOR 115 VAC OPERATION - 2 AMP	75915	313-002
	FOR 230 VAC OPERATION - 1 AMP	75915	313-001
(XF1)	FUSEHOLDER, PANEL MOUNT, TYPE 3AG	14304	XX020000
FL1	LINE FILTER ASSY	14304	805-0047 ~~FL908051~~
J1-J2	JACK, TYPE BNC	96918	UG-625B/U
M1	METER, PANEL	14304	MX068051
R1	RES, FILM, 6.8K, 5%, 1/2W	87730	LCA0411
R2	RES, FILM, 8.2K, 5%, 1/4W	87730	LCA0309
S1	SWITCH, ROCKER, ILLUMINATED, DPDT	14304	SX070000
S2	SWITCH, SLIDE, DPDT	14304	SX090022
S3	SWITCH, SLIDE, DPDT	14304	SX090122
T1	TRANSFORMER, POWER, 115/230 VAC	14304	TX918051
---	AIR FILTER	14304	805-0045
---	AIR FILTER GASKET	14304	805-0046
---	TERMINAL, METAL PUSH-ON, FEMALE	91886	12047-0
---	TERMINAL, FEEDTHROUGH (+28V)	74970	260-301
---	BKT, MTG, AMPL HEATSINK:		
	SERIAL NOS. 293 AND LATER		
	UPPER BKT	14304	805-0083
	LOWER BKT	14304	805-0084
	SERIAL NOS. BEFORE 293		
	UPPER BKT	14304	805-0058-1
	LOWER BKT	14304	805-0058-2

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
	POWER SUPPLY REGULATOR ASSY (INCLUDES REGULATOR ASSY A1 AND HEATSINK MTD PARTS-A2)	14304	805-0053
A1	REGULATOR PCB ASSY	14304	805-0037
A1C1-C2	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A1CR1	DIODE, GER, 1N277	72982	1N277
A1Q1-Q2	XSTR, SIL, PNP, 2N4354	07263	2N4354
A1Q3	XSTR, SIL, NPN, 2N3568	07263	2N3568
A1R1	RES, FILM, 820 OHMS, 5%, 1/4 W	87730	LCA0309
A1R2	POT, HORIZONTAL PCB MTG, 1 K, LINEAR	14304	RX201102
A1R3	RES, FILM, 4.7K, 5%, 1/4W	87730	LCA0309
A1R4	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A1R5	RES, FILM, 470 OHMS, 5%, 1/4W	87730	LCA0309
A1R6	RES, FILM, 220 OHMS, 5%, 1/4W	87730	LCA0309
A1R7	POT, HORIZONTAL PCB MTG, 1 K, LINEAR	14304	RX201102
A1R8	RES, FILM, 68 K, 5%, 1/4W	87730	LCA0309
A1R9	RES, FILM, 1.5 K, 5%, 1/4W	87730	LCA0309
A1R10	RES, FILM, 2.2K 5%, 1/2W	87730	LCA0411
A1R11	RES, FILM, 18 K, 5%, 1/4W	87730	LCA0309
A1VR1	DIODE, ZENER, 5.1V, 5%, 400 MW, 1N751A	81483	1N751A
A1VR2	DIODE, ZENER, 18 V, 5%, 400 MW, 1N967B	81483	1N967B
A2	POWER SUPPLY HEATSINK MTD PARTS:	-----	REF
A2C1	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A2Q1	XSTR, SIL, NPN, 2N3054	79089	2N3054
A2Q2	XSTR, SIL, NPN, 2N3055	79089	2N3055
A2R1	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A3	OVERDRIVE AMPLIFIER PCB ASSY	14304	805-0035
A3C1-C2	CAP, CER, 330 PF, 10%, 500 VDCW	91418	JG
A3C3	CAP, CER, 0.1 UF, +80-20%, 100 VDCW, 0.7 IN. DIA, SINGLE DISC	91418	TA
A3C4	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A3C5	CAP, CER, 0.1 UF, +80-10%, 500 VDCW, 0.7 IN. DIA, SINGLE DISC	91418	TA
A3C6-C7	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A3CR1-CR2	DIODE, GER, 1N277	72982	1N277
A3CR3	NOT ASSIGNED		

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
A3CR4	DIODE, SIL, 1N914	06537	1N914
A3CR5	DIODE, SIL, 1N2070	14304	CR102070
A3Q1-Q2	XSTR, FIELD-EFFECT, N-CHANNEL	14304	QX050588
A3Q3	XSTR, SIL, PNP, 2N4354	07263	2N4354
A3Q4-Q6	XSTR, SIL, NPN, 2N3568	07263	2N3568
A3R1	RES, FILM, 2.2 MEGO, 5%, 1/4W	87730	LCA0309
A3R2-R3	RES, FILM, 4.7 K, 5%, 1/4W	87730	LCA0309
A3R4-R5	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A3R6	RES, FILM, 1.2 K, 5%, 1/4W	87730	LCA0309
A3R7	RES, FILM, 12 K, 5%, 1/4W	87730	LCA0309
A3R8	RES, FILM, 100 K, 5%, 1/4W	87730	LCA0309
A3R9	RES, FILM, 12 K, 5%, 1/4W	87730	LCA0309
A3R10	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A3R11	POT, VERTICAL PCB MTG, 10 K, LINEAR	14304	RX200103
A3R12	RES, FILM, 3.9 K, 5%, 1/4W	87730	LCA0309
A3R13	RES, FILM, 2.2 MEGO, 5%, 1/4W	87730	LCA0309
A3R14	RES, FILM, 6.8 K, 5%, 1/4W	87730	LCA0309
A3R15	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A3R16	RES, FILM, 100 K, 5%, 1/4W	87730	LCA0309
A3R17	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A3R18-R19	RES, FILM, 1 K, 5%, 2W	87730	LCA0922
A3R20	POT, VERTICAL PCB MTG, 10 K, LINEAR	14304	RX200103
A3R21-R22	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A3VR1	DIODE, ZENER, 5.1V, 5%, 400 MW, 1N751A	81483	1N751A
---	AMPLIFIER ASSY, RF (INCLUDES PREAMPLIFIER AND DRIVER PCB ASSY A4, HEATSINK MTD COMPONENTS A5, OUTPUT TRANSFORMER ASSY A6, AND OUTPUT TRANSISTOR ASSY A8)	14304	805-0029

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
A4	PREAMPLIFIER AND DRIVER PC BOARD ASSY	14304	805-0030
A4C1-C2	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C3	CAP, CER, 100 PF, 5%, N750, 500 VDCW	91418	CG
A4C4-C7	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C8	CAP, CER, 4.7 PF, ±.25 PF, NPO 500 VDCW	91418	CG
A4C9	CAP, VAR, TRIMMER, 8-50 PF	14304	CX188051
A4C10-C14	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C15	NOT ASSIGNED		
A4C16	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C17	NOT ASSIGNED		
A4C18	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C19-C20	NOT ASSIGNED		
A4C21	CAP, CER, 6.8 PF, 5%, NPO, 500 VDCW	91418	CG
A4C22-C23	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A4C24	CAP, CER, 33 PF, 5%, NPO, 500 VDCW	91418	CG
A4C25	CAP, CER, 6.8 PF, 5%, NPO, 500 VDCW	91418	CG
A4C26-C27	CAP, CER, 3.3 PF, ± .25 PF, NPO, 500 VDCW	91418	CG
A4C28	NOT ASSIGNED		
A4C29-C30	CAP, CER, 5%, N750, 500 VDCW; VALUE SELECTED FROM 15, 33, 47, AND 68 PF	91418	CG
A4CR1	DIODE, SIL, 1N914	06537	1N914
A4CR2	DIODE, GER, 1N277	81483	1N277
A4CR3	DIODE, SIL, 1N914	06537	1N914
A4CR4-CR6	NOT ASSIGNED		
A4CR7-CR8	DIODE, SIL, 1N914	06537	1N914
A4L1	NOT ASSIGNED		
A4L2-L4	CHOKE BEAD	14304	EX140000

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
A4Q1-Q4	XSTR, SIL, NPN, 2N5179	79089	2N5179
A4Q5	XSTR, SIL, NPN, 2N5133	07263	2N5133
A4Q6-Q7	XSTR, SIL, NPN, 2N5179	79089	2N5179
A4Q8-Q15	XSTR, SIL, NPN, 2N5109	79089	2N5109
A4R1	RES, FILM, 100 OHMS, 5%, 1/2W	87730	LCA0411
A4R2-R3	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A4R4	RES, FILM, 1.8 K, 5%, 1/4W	87730	LCA0309
A4R5	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A4R6	RES, FILM, 22 OHMS, 5%, 1/4W	87730	LCA0309
A4R7	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309
A4R8	RES, FILM, 820 OHMS, 5%, 1/4W	87730	LCA0309
A4R9	RES, FILM, 220 OHMS, 5%, 1/4W	87730	LCA0309
A4R10	RES, FILM, 1 K, 5%, 1/4W	87730	LCA0309
A4R11-R12	RES, FILM, 100 OHMS, 5%, 1/4W	87730	LCA0309
A4R13-R14	RES, FILM, 680 OHMS, 5%, 1/4W	87730	LCA0309
A4R15	RES, FILM, 47 OHMS, 5%, 1/4W	87730	LCA0309
A4R16	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A4R17	RES, FILM, 100 OHMS, 5%, 1/2W	87730	LCA0411
A4R18	RES, FILM, 100 OHMS, 5%, 1/4W	87730	LCA0309
A4R19	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309
A4R20-R21	RES, FILM, 100 OHMS, 5%, 1/4W	87730	LCA0309
A4R22	RES, FILM, 1.5K, 5%, 1/4W	87730	LCA0309
A4R23	RES, FILM, 470 OHMS, 5%, 2W	87730	LCA0922
A4R24	RES, FILM, 1.5 K, 5%, 1/4W	87730	LCA0309
A4R25	RES, FILM 470 OHMS, 5%, 2W	87730	LCA0922
A4R26-R27	RES, FILM, 27 OHMS, 5%, 1/4W	87730	LCA0309
A4R28	RES, FILM, 100 OHMS, 5%, 1/4W	87730	LCA0309
A4R29-R30	RES, FILM, 220 OHMS, 5%, 1/4W	87730	LCA0309
A4R31-R32	RES, FILM, 330 OHMS, 5%, 2W	87730	LCA0922
A4R33-R34	RES, FILM, 27 OHMS, 5%, 1/4W	87730	LCA0309
A4R35-R42	RES, FILM, 330 OHMS 5%, 2W	87730	LCA0922
A4R43-R46	RES, FILM, 22 OHMS, 5%, 1/4W	87730	LCA0309
A4R47	RES, FILM, 470 OHMS, 5%, 1/2W	87730	LCA0411

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
A4R48	RES, FILM, 100 OHMS, 5%, 1/4W	87730	LCA0309
A4R49-R52	NOT ASSIGNED		
A4R53-R54	RES, FILM, 220 OHMS, 5%, 1/4W	87730	LCA0309
A4R55-R56	RES, FILM, 22 OHMS, 5%, 2W	87730	LCA0922
A4R57	RES, FILM, 180 OHMS, 5%, 1/4W	87730	LCA0309
A4R58	RES, FILM, 470 OHMS, 5%, 1/2W	87730	LCA0411
A4R59	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309
A4T1	TRANSFORMER, INPUT	14304	TX928051
A4VR1	DIODE, ZENER, 18V, 5%, 400 MW, 1N967B	81483	1N967B
A5	HEATSINK MTD PARTS:	-----	REF
A5C1-C2	CAP, CER, 33 PF, 5%, NPO, 500 VDCW	91418	CG
A5C3	CAP, CER, 0.1 UF, +80-20%, 100 VDCW, 0.7 IN. DIA, SINGLE DISC	91418	TA
A5CR1-CR3	NOT ASSIGNED		
A5CR4-CR6	DIODE, SIL, 1N2070	14304	CR102070
A5L1	CHOKE ASSY	14304	LX908052
A5L2-L4	NOT ASSIGNED		
A5L5	CHOKE	14304	LX918051
A5R1-R2	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309
A5R3	NOT ASSIGNED		
A5R4	POT, 10 OHMS, LINEAR, 2W	14304	RX370100
A5R5	RES, FILM, 10 OHMS, 5%, 2W	87730	LCA0922
A5R6	RES, WW, 150 OHMS, 5%, 10W	14304	RX170151
A5R7	RES, FILM, 10 OHMS, 5%, 2W	87730	LCA0922
A5R8-R9	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309
A5R10-R31	NOT ASSIGNED		
A5R32	RES, FILM, 33 OHMS, 5%, 2W	87730	LCA0922
A5S1	THERMOSTAT	14304	SX138051
A6	OUTPUT TRANSFORMER ASSY	14304	805-0027
A7	METER CIRCUIT PCB ASSY	14304	805-0038
A7C1-C4	CAP, CER, 0.1 UF, +80-20%, 100 VDCW, 0.7 IN. DIA, SINGLE DISC	91418	TA

TABLE 6-1. REPLACEMENT PARTS LIST (Cont)

REF DESIG	DESCRIPTION	MFR CODE	PART NO.
A7C5	CAP, CER, 330 PF, 10%, 500 VDCW	91418	JG
A7CR1-CR4	DIODE, GER, 1N277	72982	1N277
A7CR5	DIODE, SIL, 1N914	06537	1N914
A7R1	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A7R2	RES, FILM, 100 K, 5%, 1/4W	87730	LCA0309
A7R3	POT, HORIZONTAL PCB MTG, 50 K	14304	RX201503
A7R4	RES, FILM, 22 K, 5%, 1/4W	87730	LCA0309
A7R5	RES, FILM, 120 K, 5%, 1/4W	87730	LCA0309
A7R6	RES, FILM, 27 K, 5%, 1/4W	87730	LCA0309
A7R7	RES, FILM, 47 K, 5%, 1/4W	87730	LCA0309
A7R8	POT, HORIZONTAL PCB MTG, 10 K	14304	RX201103
A7R9	RES, FILM, 10 K, 5%, 1/4W	87730	LCA0309
A7R10	RES, FILM, 2.2 K, 5%, 1/4W	87730	LCA0309
A7R11	RES, FILM, 4.7 K, 5%, 1/4W	87730	LCA0309
A7R12	RES, FILM, 1.8 K, 5%, 1/4W	87730	LCA0309
A8	OUTPUT TRANSISTOR ASSY	14304	805-0080
A8C1-C2	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A8C3	NOT ASSIGNED		
A8C4-C7	CAP, CER, 15 PF, 5%, NPO, 500 VDCW	91418	CG
A8C8	CAP, TANT, 6.8 UF, 35 VDCW	14304	CX15068350
A8CR1-CR2	DIODE, SIL, 1N914	06537	1N914
A8CR3	DIODE, GER, 1N277	72982	1N277
A8D1-D2	CABLE, RIGID COAXIAL, 2 IN. LENGTH	93306	UT-25
A8L1-L2	NOT ASSIGNED		
A8L3-L4	CHOKE ASSY, BASE	14304	LX908051
A8Q1-Q6	XSTR, SIL, NPN, RF POWER	14304	QX950805
A8R1-R7	NOT ASSIGNED		
A8R8-R31	RES, FILM, 10 OHMS, 5%, 1/4W	87730	LCA0309

TABLE 6-2. GLOSSARY OF ABBREVIATIONS

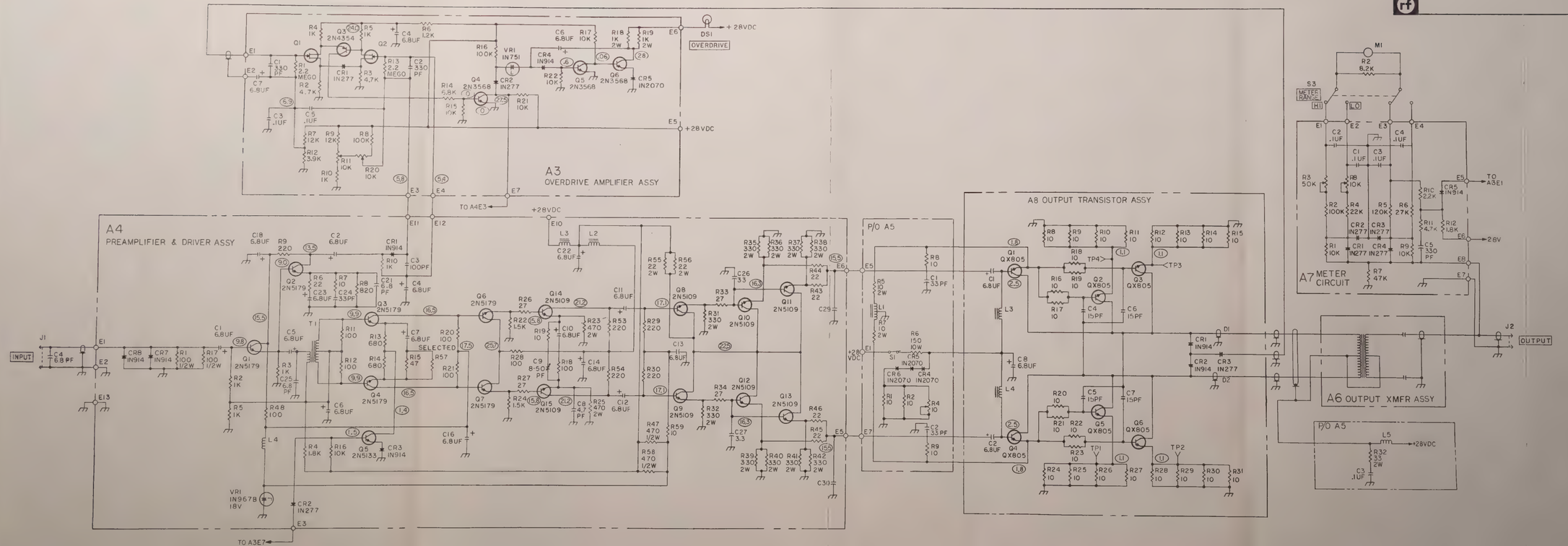
AMP	AMPERES	PCB	PRINTED-CIRCUIT BOARD
AMPL	AMPLIFIER		
BKT	BRACKET	PF	PICOFARADS
CAP	CAPACITOR	POT	POTENTIOMETER
CER	CERAMIC	REF	REFERENCE LISTING
DIA	DIAMETER	RES	RESISTOR
DPDT	DOUBLE-POLE, DOUBLE-THROW	SIL	SILICON
		TANT	TANTALUM
GER	GERMANIUM	UF	MICROFARADS
IN.	INCHES	V	VOLTS
K	KILOHMS	VAR	VARIABLE
MEGO	MEGOHMS	VDCW	DC WORKING VOLTS
MTD	MOUNTED	W	WATTS
MTG	MOUNTING	WW	WIREWOUND
MW	MILLIWATTS	XSTR	TRANSISTOR

TABLE 6-3. LIST OF ASSEMBLIES

ASSY/SUBASSY	REF DESIG PREFIX
CHASSIS AND PANEL ASSY	(NONE)
POWER SUPPLY REGULATOR ASSY, INCLUDES:	(NONE)
REGULATOR PCB ASSY	A1
HEATSINK MTD PARTS	A2
OVERDRIVE AMPLIFIER PCB ASSY	A3
RF AMPLIFIER ASSY, INCLUDES:	(NONE)
PREAMPLIFIER & DRIVER PCB ASSY	A4
HEATSINK MTD PARTS	A5
OUTPUT TRANSFORMER ASSY	A6
OUTPUT TRANSISTOR ASSY	A8
METER CIRCUIT PCB ASSY	A7

TABLE 6-4. LIST OF MANUFACTURERS

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
06357	ITT Industrial Prod. Div.	Lodi, N.J.
07263	Fairchild Camera & Inst. Corp.	Mt. View, Calif.
14304	R F Communications, Inc.	Rochester, N.Y.
72982	Erie Technological Products, Inc.	Erie, Pa.
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y.
74970	E. F. Johnson Co.	Waseca, Minn.
75915	Littlefuse, Inc.	Des Plaines, Ill.
79089	RCA	Harrison, N. J.
81483	International Rectifier Corp.	El Segundo, Calif.
87730	United Mineral & Chemical Corp.	New York, N.Y.
91418	Radio Materials Co.	Chicago, Ill.
91886	Malco Mfg. Co. Inc.	Chicago, Ill.
93306	Uniform Tubes	Collegeville, Pa.
96918	Kings Electronics	Tuckahoe, N.Y.



NOTES
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. TEST VOLTAGES ARE INDICATED AS (22.5) AND ARE POSITIVE WITH RESPECT TO GROUND UNLESS OTHERWISE MARKED.

Figure 6-1. Amplifier and Control Sections, Schematic Diagram

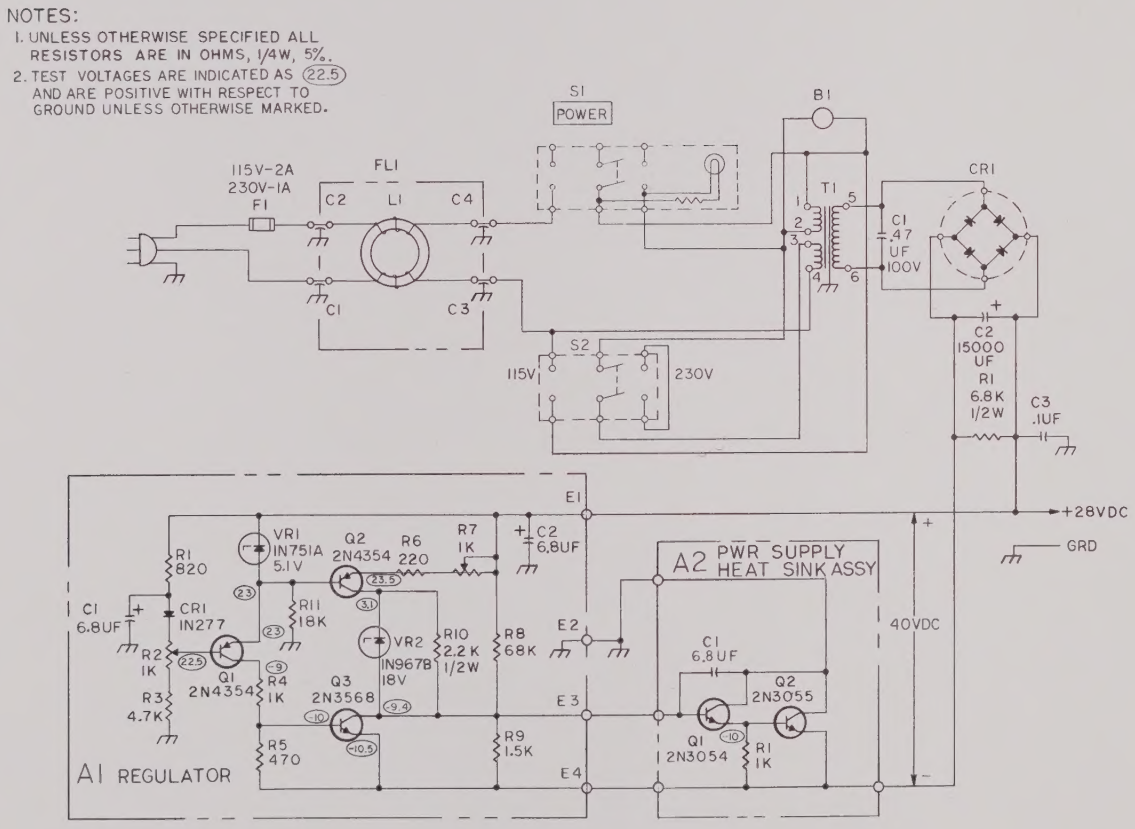


Figure 6-2. Power Supply Section, Schematic Diagram

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